THE METAL INDUSTRY
WITH WHICH ARE INCORPORATED
THE ALUMINUM WORLD, COPPER AND BRASS, THE BRASS FOUNDER AND FINISHER AND
ELECTRO-PLATERS REVIEW

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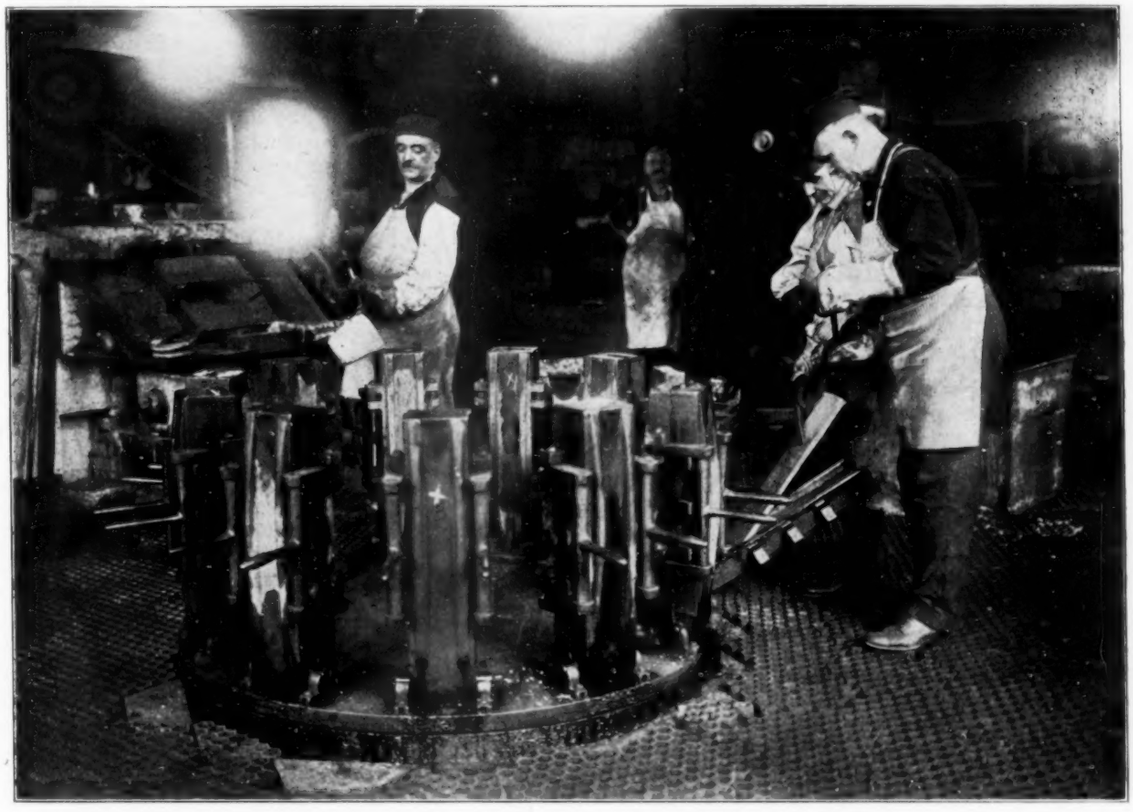
IMPROVED INGOT CASTING SET

A DESCRIPTION OF A METHOD NOW EMPLOYED BY THE UNITED STATES MINT AT PHILADELPHIA, PA.

BY H. D. COLEMAN.*

The annual demand for approximately one hundred million 1 cent bronze pieces, and 60 million 5 cent cupro-nickel pieces, has brought about changed processes in both the melting and the coining departments of the United States mint at Philadelphia.

The method of preparing ingots of bronze and cupro-nickel for minor coinage work has been entirely changed. The old process was that followed in the more exacting and deliberate work of gold and silver ingot making, that has been in use here for years. This consists in dipping one small cup into crucible of molten metal, as many times there were bars to be made. In the case of the more precious alloys above named, it meant 70 or more bars to be moulded from each pot of metal. These moulds were of cast iron, of three piece construction, held together at center by one wrought band forming a screw clamp. These moulds were nested in lots of 12 to 16 in a spill pan, their open ends being at about 26 inches from the floor. After the melter filled the double cavity in each unit, a helper, by use of heavy asbestos gloves, would (upon the chilling of the metal) pick up the filled mould and throw it upon a cast iron table for opener to release clamp and clear ingots. After which the moulds were swabbed with dope of same kind, re-clamped and replaced in pan ready for second pouring. These ingots were about 14 inches long by 3 inches wide and weighed about 4 pounds. If melting conditions were favorable, five melts of bronze or three melts of cupro-nickel, each weighing about 240 pounds,



A VIEW IN THE UNITED STATES MINT AT PHILADELPHIA, PA. SHOWING A NEW METHOD OF CASTING METAL INGOTS.

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were made per furnace in a little more than 8 hours.

The change contemplated was brought about by the demand for more coin in 8 hours. This meant either operating upon more ingots or increasing the size of rolls and increasing the size of the ingots. It was decided to install two 16-inch rolls, and increase the weight of the ingot to about 22 pounds, making its size 24 x 4¼ x ¾ inches.

The large rolls are both used as "break down" rolls and reduce the ingots in 8 passes to 70/1000 gauge. After this, the finishing is done in 10-inch rolls and in 7 more passes, the coin gauge is reached. All ingots are now being rolled to gauge without any annealing of strip; the blanks themselves, however, are annealed prior to the operation of milling, which process puts the upset edge on the discs. From these larger strips, at each stroke of the cutter, 5 cupro-nickel or 6 bronze blanks fall beneath the press. This is in place of three blanks cut in our old practice.

The problem that confronted the melting department was to devise a mould in cast iron that would turn out these large bars, lessen the labor to manufacture per pound, and increase the speed of getting metal from crucible to mould. The fact of there being 10 or 11 bars now to a full crucible (No. 80) made the lifting of the crucible from furnace and tilting above and pouring into 11 different small mouthed moulds seem hardly feasible. In the case of the cupro-nickel alloy, before the last bar would have been poured by this method, the chilling effect of the metal would be noticed to the detriment of the ingot. Direct pouring into moulds from tilting crucible and reverberatory furnaces was tried, but here where the theory sounds so true, we were unable to properly, and with any degree of precision, control the stream of molten metal, enabling a uniform stream to be poured, and check same at proper moment. There was evolved from these tests the method now practiced and the moulds used are clearly shown in cut which I now describe.

A turntable mounted upon ball bearings, carries 11 stationary vertical castings ranged equidistant on a five-foot circle. These are the plane or back pieces of the moulds. The grooved piece or mould proper, is clamped against the plane face in the vertical position, when moulds are ready to be filled. The lower end of this shell or movable part, has two lugs or trunnions which rest in two adjustable bearings bolted to table. This shell part of mould when released can only drop to a 45 degree angle, at which inclination its lower inner edge rests against the under edge of the stationary back, thus holding it firm for recovery of ingot.

The clamping device is clearly shown in cut. Two tee vertical clamp bars are made eccentric with holes in links, that tie them to plane upright. When handles point in a radial direction the slight rotation given the handle has brought the eccentric rod to bear at 3 points upon lugs of shell, thus securely clamping shell to back of mould. To release, clamp bars are slightly rotated away from mould and pulled off of lugs, when shell falls to 45 degree position. Provision against wear and for adjustment is taken care of by using an eccentric bushing in each link held in place by a set screw. With this set of moulds, two melters pour each bar, a large No. 5 graphite dipping cup being used. The second melter starting his pour just before the first empties his cup.

By this practice a melt of eleven bars can be taken off in 5 minutes. This time could not be duplicated by lifting crucible (No. 80) from furnace and pouring 11 different moulds. Besides the heat conservation, by our method, is pronouncedly ahead of lifting crucible from furnace, and the life of the crucible not endangered by temperature changes and mechanical punishment. After taking ingots from moulds they are pickled, cooled, filed and then sheared of shrinkage head. The moulds are made heavy to prevent warpage and also to provide ample metal for resurfacing. The shell weighs 130 pounds and the stationary piece 145, both have two heavy ribs the entire length of their backs. A high blast test, heavy mould oil is used for this work and we are encouraged to believe the life of these moulds on bronze will be indefinitely long; on cupro-nickel, however, with such high temperature, two years' service would be all we could expect.

MINERAL RESOURCES—COPPER.

About half way between Harput and Diarbekir, Turkey, at Arghany-Maden, is a copper mine which has been worked since prehistoric times. The output is partially refined and molded into round ingots at a near-by smelter and transported by camel caravan to Tokat, near Samsun, where it is further refined, and then shipped abroad. It is the only mine in operation in this part of the empire, but it barely pays expenses on account of the scarcity of fuel; wood is used, but it is very expensive. Until the water power from the Tigris river is utilized or a railroad is built to bring in coal it will remain an almost profitless industry.

Out of this mine runs a stream of copper water which would pay well if the copper were precipitated out of the solution, but no such attempt has been made. The government and the owners of the mine, who operate the mine together, several years ago refused a proposition made by a French civil engineer, who offered large annual payments for the privilege of recovering the copper from the stream. The process he intended to use was the precipitation of the copper from the water by means of iron filings.

NEW USES FOR INFUSORIAL EARTH.

Infusorial earth is being mined more actively in California and Nevada, which produced nearly 90 per cent. of the 6,528 tons output last year in the United States. The value averaged $10.50 per ton.

Heretofore diatomaceous or infusorial earth has been largely used as an abrasive in the form of polishing powders and scouring soaps, but the United States Geological Survey finds that of late its uses have been considerably extended. Because of its porous nature it has been used in the manufacture of dynamite as a holder of nitroglycerine, but so far as known not in the United States. Its porosity also renders it a nonconductor of heat, and this quality in connection with its lightness has extended its use as an insulating packing material for safes, steam pipes and boilers, and as a fireproof building material. In this country a new use of the material is reported in the manufacture of records for talking machines. For this purpose it is boiled with shellac, and the resulting product has the necessary hardness to give good results.

In Europe, especially in Germany, infusorial earth has lately found extended application. It has been used in preparing artificial fertilizers, especially in the absorption of liquid manures; in the manufacture of water glass, of various cements, of glazing for tiles, of artificial stone, of ultramarine and various pigments, of aniline and alizarine colors, of paper, sealing wax, fireworks, gutta-percha objects, Swedish matches, solidified bromine, scouring powders, papier-mâché, and many other articles. There is a large and steadily growing demand for it.

METAL SPRAYING

A Description of a New Process for the Production of a Metallic Coating on Any Material.

By R. K. Morcom.

The spraying of metals from the molten state in order to produce a powder is an old idea, and the spraying of a liquid to produce a covering of paint, varnish, or enamel is also well known. The subject of this paper is akin to them both, but has for its object the production of uniform metal deposits by means of a spraying process.

The exact theory of the process is complex, and at present not completely understood. The spraying may be accomplished in various ways. Practical experience is demonstrating how apparatus of increasing technical convenience for the purpose may be made.

The earliest attempts were carried out by melting the metal in a pot, forcing it through a fine nozzle under high pressure, and then with steam or a gas spraying it on to a surface. The apparatus developed for this purpose was in many ways troublesome and cumbersome, and the use of it was practically confined to metals and alloys of low melting point. The spraying medium was kept hot by various devices, and an attempt was made to keep the metal molten right up to the moment of application.*

The fact, however, was observed that under conditions of temperature and expansion of the gases such that the metal could not have been molten throughout the process, adherent coatings were sometimes formed. These experiments, and careful observations of the spreading and adhesion of bullets fired at an iron plate, suggested the next stage of development.

Metallic powders were driven at high velocity against the body to be coated by means of gaseous jets expanded from considerable pressure.†

The results achieved were a great improvement on the older method.

To produce the metallic powders the metal had, of course, to be subjected to one of the known pulverizing processes, such as distillation, grinding, or spraying. The suggestion that the pulverization and deposition could be combined in one apparatus was then made by the inventor Schoop; and his researches resulted in the perfecting of the apparatus covered by his colleague Morf in British Patent No. 2801, 1912.

The steady improvement of this apparatus in the laboratories of Schoop and his associates has resulted in the machine (Figs. 1 and 2), the construction, working, and theory of which will be described in this paper.

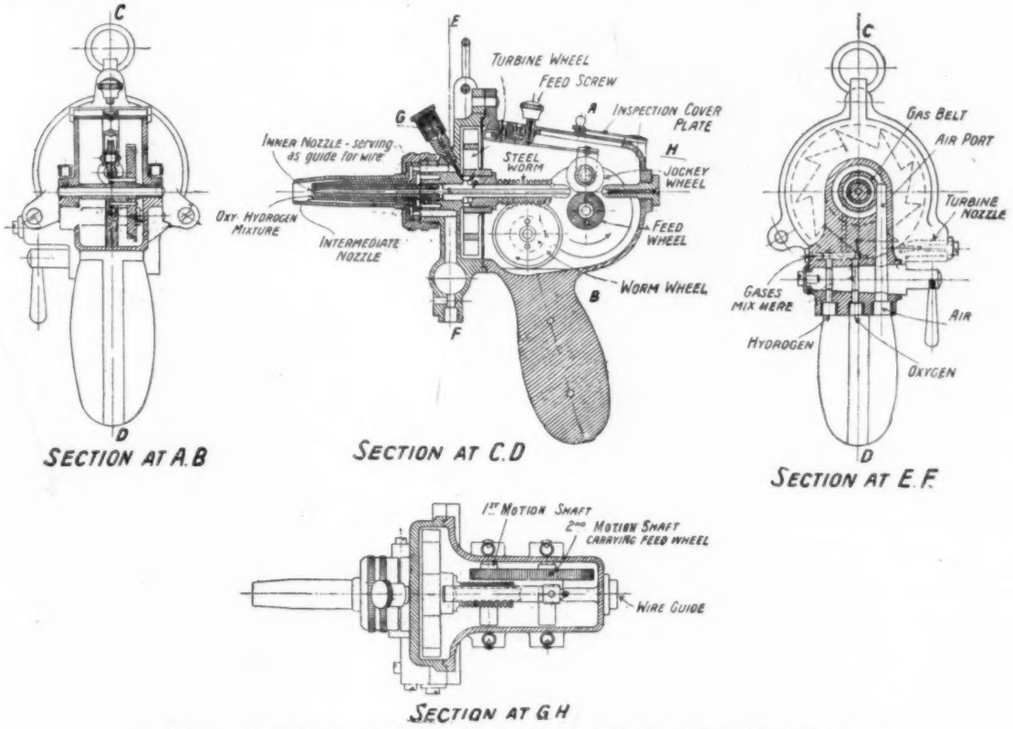

FIG. 1. SECTIONAL DRAWING OF THE SPRAYING MACHINE OR "PISTOL."

The essential parts of the machine, or "pistol" as it is called, are a combined melting and spraying jet and a feed mechanism. The metal, in the form of rod or wire, is fed to the melting flame. The flame can be formed by coal-gas, water-gas, acetylene, hydrogen, etc., burning in air or oxygen according to the metal used. The gases are supplied at such pressures as to prevent blowing out and to ensure a highly deoxidizing flame. The spraying jet can be of carbon dioxide, nitrogen, air, steam, etc.; it is fed at such a pressure as to produce a sufficiently high velocity for successful coating. The various pressures must be carefully kept constant by accurate gauges and reducing valves.

The feeding of the wire is accomplished by a small pneumatic motor, driven by the spraying medium either in series or parallel with the main jet.

The dimensions of the wire, nozzle, and feed mechan-

* See British Patent No. 5712, 1910, M. U. Schoop; also Journal of the Institute of Metals, vol. iv., No. 2, 1910, p. 307; also No. 1, 1911, vol. v., p. 321.

† See Schoop, British Patent No. 21066, 1911.

ism vary with the different metals, and the nozzles and feed mechanism are so designed as to be readily interchangeable.

For small work hand operation is sufficient; but, probably, when large work is undertaken, it will prove convenient to have mechanical traverse and control.

To obtain the best adhesion, the surface on to which the metal is sprayed must be thoroughly clean and of an open nature to give a key for the deposit. Sand-blasting with sharp sand has been found best. Shot gives too polished a surface. Such surfaces as fabrics, wood, unglazed earthenware, and asbestos require only freedom from grease, as their surfaces give a natural key.

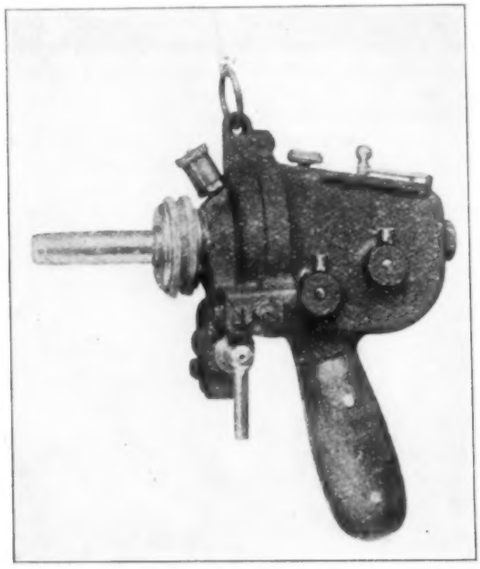

FIG. 2. THE SPRAYING MACHINE.

The mention of wood and fabrics as suitable substances to coat by means of an apparatus in which an intense flame is used may cause some surprise, which will be increased by the statement that celluloid, and even explosives, can be safely metal sprayed.

To make this less remarkable it will be well to enter here upon a brief account of the theory so far developed to explain the operation, referring to Fig. 4.

The melting jet is focused on the tip of the wire. The spraying jet, cold from expansion, strongly draws forward the products of combustion in the centre of its cone, and by its draught drags off minute particles of metal, either in the plastic or molten state. The central cone, therefore, consists of metal particles, some cooled to solidity, some molten, and some, perhaps, gaseous, surrounded by a protective reducing atmosphere.

This cone is hurled forward with great velocity on to the object to be coated by the outer jet.

With a given design of jet there is only a certain volume left by the air-jet which can be filled with flame, and this flame has a limiting temperature which cannot be exceeded. The wire, passing through this cone of flame, receives heat, partly by radiation, but chiefly by conduction, and becomes melted; but there is a definite limit to the amount of heat which can be picked up by the wire passing through the flame, and a definite limit to the rate at which it can be melted. This cannot be increased by forcing more gas into the flame, as the extra gas is merely blown away by the air-jet. It is possible to increase the rate of melting by shaping the nozzles so as to leave room for a larger cone of flame, and experiments are in progress on this point. There is, therefore, a definite most economical quantity of gas which should be used in the pistol, this quantity being about 1.5 cubic foot of hydrogen per minute, and 0.5 cubic foot of oxygen; or about 0.8 cubic foot of coal-gas to 0.65 cubic foot of oxygen for the present standard designs.

In refractory metals these quantities may be increased slightly, as a slightly higher temperature can be obtained if the burning gases are under a pressure greater than atmospheric, and this occurs if the gas quantities are increased, the inner surface of the air-jet acting to some extent as an enclosing wall to the flame. On the other hand, for the more easily fusible and oxidizable metals, such as tin, lead, and zinc, it is advisable to keep the gas quantities rather below the figure given, so as to avoid any possibility of overheating and burning any portion of the wire.

The outer jet performs a threefold purpose, it keeps the nozzles and wire cool, it cools the object, and it produces the requisite velocity.

The velocity of the air leaving the jet will be independent of the volume discharged, and depends only upon the pressure at the jet, so long as there is no disturbance due to the entraining of air from the surrounding atmosphere. This, of course, will actually occur in practice, and the layer of air must have a certain thickness in order to prevent its being broken up, and its velocity destroyed by mixing with the surrounding atmosphere.

In addition to this, the air-jet has to atomize the molten metal, and accelerate the particles up to its own velocity, so that to perform this a certain mass of air is required.

As at present constructed the standard pistol uses about 0.55 to 0.6 cubic foot per minute for every 1 lb. per square inch air pressure, so that with an air supply at 80 lb. per square inch, which is a very suitable figure for ordinary spraying, the air consumption will be from 45 to 50 cubic feet per minute.

FIG. 3. THE "PISTOL" COUPLED UP FOR HAND WORKING.

The mass of this will be from 830 to 920 grammes, and the mass of metal sprayed by this air will be from about 8 grammes in the case of iron to about 200 grammes in the case of lead.

How effective the cooling is, is readily shown by the fact that the hand can be held in the jet, so as to receive a coating of metal, without inconvenience.

Samples are shown of wood and fabrics coated with metal and quite undamaged.

The action of deposition is probably a complex one. The minute particles of solid metal are driven with such force against the object that, in some cases, they fuse, but, owing to their small relative size, are promptly chilled by the object to which they adhere. If any of the particles are molten or gaseous they will adhere. In addition, the suddenly chilled particles are possibly, or even probably, in the state of unstable equilibrium found in "Prince Rupert's Drops," and act like so many minute bombs, bursting on impact into almost molecular dimensions, and penetrating the smallest cracks and fissures of the object.

The process requires some care in manipulation as, by varying the conditions, it is possible to spray porous or non-porous coatings, and, with some metals, anything from a pure metal to a pure oxide. With care, however, non-porous, oxide-free, adherent coatings can be produced, of almost any metal on almost any solid.

In addition to metals, it is possible to spray fusible non-metals, or, by stranded wires, alloys of metals or mixture of metals with non-metals.

The process is so new that its uses are still partly to be developed. But it is easy to see that it may have far-reaching value for protective coatings against weather or fire, for ornament, for electrical resistance and conductors, for the production of special alloys, for joint making, and for many other purposes.

Quite in a different category comes that of very fine casting. The surface of a pattern, polished or slightly greasy, is most minutely copied, and it is possible to produce process blocks very rapidly. It may be useful to line moulds before pouring in a metal. The application of the process to the production of very fine or coarse metallic powders is being investigated.

The costs of the process are not prohibitive, and, even where higher than alternative processes, the great range and adaptability of this apparatus, and its independence of muffles, pots, etc., may make it preferable.

A table of gas-pressure and feed rates is appended to give some idea of costs. Experience and extended use on a commercial scale should soon reduce the cost of operation.

The bulk of the work has hitherto been carried on in laboratories, but the apparatus is gradually becoming used in the more progressive factories, where extended facilities, and the knowledge of specialized requirements, will ensure a rapid improvement in technique and results.

The research on the lower melting-point metals has been greater than on the others, and undoubtedly the economy with them both can be greatly improved. Preheating of gases and air, supplementary flames acting in front of the main jet, and electrical methods of heating, are all still the subject of experiment.

That the experimental stage has been passed for many uses can be seen from the apparatus and sample of work done, which accompany this paper.

Table I.—Weight of 1 Square Foot of Various Metals Coated to a Thickness of 0.001 inch.

Metal.	Density. C. G. S.	Density. British, lb. per Cubic Foot.	Weight. Lb.	Weight. Grammes.	Metal only. Price, Pence per lb.	Metal only. Cost, Pence.
Aluminum	2.65	177	0.0148	6.62	12.5	0.186
Brass	8.5	537	0.045	20.2	8.0	0.36
Bronze	8.8	565	0.047	21.1	9.5	0.45
Copper	8.9	560	0.0468	21.0	10.0	0.47
Cupro nickel ...	8.9	560	0.0468	21.0	...	...
Iron	7.8	492	0.041	18.4	3.5	0.144
Gold	19.3	1210	0.101	45.5	...	...
Nickel	8.9	560	0.0468	21.0	36.0	1.68
Silver	10.5	660	0.055	29.7	...	...
Tin	7.3	460	0.0384	17.3	30.0	1.15
Zinc	7.1	450	0.0376	16.9	11.0	0.415
Lead	11.4	720	0.0600	26.9	3.25	0.195

Table II.—Data for Spraying Various Metals.

Metal.	Diameter of Wire used, Millimetres.	Rate of Feed, Grammes per Minute.	Gas used per Minute, Cu. Ft. Hydrogen.	Oxygen.	Coal Gas.	Oxygen.
Aluminum	1.0	9.5	1.5	0.5	0.7	0.6
Brass	0.8	17	1.5	0.5	0.8	0.65
Bronze	0.8	17	1.5	0.5	0.8	0.65
Copper	0.8	14	1.8	0.6	..	..
Cupro nickel	0.8	12	1.8	0.6	..	..
Gold	0.8	45	1.5	0.5	..	..
Iron	0.8	8	2.0	0.7	..	..
Lead	3.0	300	1.0	0.35	0.45	0.4
Nickel	0.8	9	2.0	0.7	..	..
Silver	0.8	18	1.5	0.5	..	..
Tin	2.0	200	0.8	0.3	0.35	0.30
Zinc	1.0	45	1.2	0.45	0.55	0.5

Blanks in Coal Gas column indicate that experiments with these metals are not yet complete.

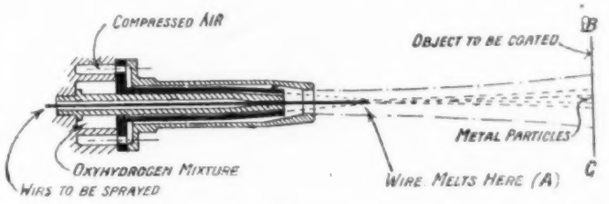

FIG. 4. DIAGRAMMATIC REPRESENTATION OF MELTING AND SPRAYING JETS IN ACTION.

MID-YEAR SPELTER STATISTICS, 1914.

Figures compiled by C. E. Siebenthal, of the United States Geological Survey, from reports by all zinc smelters operating during the first six months of 1914 show that the production of spelter from domestic ore in that period was 171,496 short tons and from foreign ore 3,562 short tons, a total production of 175,058 tons, compared with 166,463 tons for the last half of 1913 and 180,213 tons for the first half. The spelter made in Illinois increased about 9,000 tons, that made in Kansas declined about 8,000 tons, and that made in Oklahoma increased about 5,000 tons, compared with the quantities of spelter made in those States during the last six months of 1913. The stock of spelter held at smelters on June 30, 1914, was 64,039 tons, against 40,659 tons at the beginning of the year and 21,856 tons at the middle of 1913.

From the foregoing figures and the records of the Bureau of Foreign and Domestic Commerce it is calculated that the apparent consumption for the period was 149,363 tons, which, compared with 132,387 tons for the last half of 1913 and 153,073 tons for the first half, seems not much below the normal.

THE COMMERCIAL CLASSIFICATION OF REFINED COPPER*

SOME INFORMATION RELATING TO COPPER OF VALUE TO CONSUMERS AND NOT GENERALLY KNOWN.

By Lawrence Addicks.

Any adequate classification of a material of commerce such as copper must take into account both the limitations of the metallurgical processes by which the material has been obtained and the needs of the manufacturing processes in which it is to be employed. The metallurgical methods depend in turn upon the nature of the ores or other sources of supply and the manufacturing ones upon the ultimate uses of the finished product.

The world's copper supply comes from four main sources, sulphide ores, oxidized ores, native ores and scrap. Perhaps the chief chemical characteristic of copper is its affinity for sulphur and the largest deposits of copper ores consist of more or less complex sulphides. Near the surface these ores are frequently altered to oxides and carbonates by atmospheric influence and there are also large deposits entirely free from sulphur. Native copper ores where the copper exists as free metal occur in various parts of the world in small quantities, but notably in the enormous deposits in the northern peninsula of Michigan, where they form the source of the so-called Lake Copper.

Metallurgically there are three typical processes for producing crude or unrefined copper from the ore, based on the general principles of oxidizing sulphides and reducing oxides, (a) roasting, smelting and converting, (b) alternate oxidation and reduction and (c) direct reduction of oxidized ores. (a) which is a strongly oxidizing process by which the great majority of the American production is made from sulphide ores, results in the almost complete elimination of impurities which have volatile oxides, including some of the worst enemies of refined copper, such as arsenic. Converter bar nearly always runs 99 per cent copper plus silver and is not likely to carry more than a few hundredths of a per cent. of any impurity but nickel. (b) is the old Welsh process, still used to some extent abroad, based upon the reaction between copper oxides and sulphides to eliminate sulphur as sulphur dioxide gas and carried out in a long series of roasts and fusions in reverberatory furnaces. The removal of impurities is here imperfect although they may be to a certain extent segregated in a portion of the product, whence the origin of the "Best Selected" copper of Great Britain. When the ores are wholly oxidized the copper may be recovered by direct reduction in a blast furnace (c) and as this is a strictly reducing process the resulting black copper seldom runs over 96 per cent., due to iron and other impurities reduced.

Except in the case of "Best Selected" and similar English coppers, all of the products from the foregoing processes are given a further treatment or refining, which may be broadly divided into furnace or fire refining and electrolytic refining.

Fire refining is based upon the scorifying effect of cuprous oxide upon base metals contained in a bath of molten copper. The crude copper is melted in a reverberatory furnace and air blown into the bath. Suprous oxide rapidly forms and dissolves in the bath, the blowing being stopped at or before the saturation point. In this way oxygen is carried to all parts of the molten bath and when there are any metals present which are more easily oxidized than copper, cuprous oxide is reduced back to copper and the oxide of the impurity is formed. If this oxide is not soluble in the molten copper it will float to the surface where it may be removed by skimming. As copper stands high among metals in the order of nobility the metallic impurities with the exception of the precious metals may be readily removed in theory. In practice while elimination proceeds rapidly while considerable quantities of impurities are present, the rate diminishes until traces are reached which cannot be slagged off with any reasonable amount of scorifying. Therefore furnace refining is limited in its application to relatively pure crude copper unless a low grade refined copper is contemplated. Less than ten dollars' worth of silver and gold per ton will justify electrolytic refining.

Returning to the bath of molten copper which has been skimmed clean, it is necessary to reduce the excess cuprous oxide dissolved, and no better way has yet been devised than the old Welsh process of covering the bath with a protecting layer of charcoal or low sulphur coke and then forcing the butts of green trees or poles or hardwood beneath the surface by means of suitable tackle. The cuprous oxide is reduced in this way until a normal amount corresponding to an oxygen content of from 0.04 to 0.07 per cent. is left when the copper develops its best physical characteristics, the condition of the copper being followed by the appearance of the fracture of small buttons cast in a spoon or "say ladle" which is a sort of ductility test and by the swell or depression of the surface of an ingot as it cools, which indicates the gas content. The copper is then cast by means of one of the several types of ladling machines which have been very successfully developed in recent years.

When the copper is to be electrolytically refined it is first given a rough furnace refining and cast into anode plates, which are then electrolyzed in a strongly acid solution of copper sulphate. The same order of nobility applies, but the great preponderance of copper over the impurities is now an aid as it assists the selective action of the current in depositing only copper at the cathode. Silver and gold are also saved as they are insoluble in the electrolyte chosen and fall to the bottom of the tank as anode mud or slimes to be separately refined and parted.

It is quite evident that copper entering an electrolytic refinery must entirely lose its identity and that the purity of the resulting cathode copper will depend upon the conditions under which electrolysis is carried out rather than upon the momentary quality of the day's anodes. Therefore it is not necessary to consider whether the input be converter bar, black copper or Lake mineral when buying electrolytic, but simply whether the product meets the accepted standards of quality for electrolytic copper.

Electrolytic cathodes should be very pure. They generally run about 99.95 per cent. copper, much of the missing 0.05 per cent. probably being hydrogen. The metallic impurities generally total about 0.02 per cent. Except for the fact that individual cathodes may vary more or less in impurity content they are ideal material for brass making. Copper producers, however, have never encouraged the sale of cathodes, as there is apt to be some shrinkage in weight during shipment owing to the comparative ease with which nodules or small pieces can be detached either accidentally or intentionally. Also cathode shipments unbalance the work in a refinery in proportion to their magnitude, as melting cathodes into market shapes is a distinct part of the process.

This melting is done in a reverberatory furnace and originally was an exact duplication of the fire refining al-

*A paper presented at the Annual Meeting of the American Institute of Metals, September 7-11, 1914, at Chicago, Ill.

ready described. As the cathode copper is already pure, a simple melting is all that should be required, but molten copper is so susceptible to contamination that until recently the gases from combustion, iron in the rabbles, etc., were absorbed to a sufficient extent to require actual refining. At the present time large quantities of cathodes are being added to the molten charge during ladling and earlier, basic furnaces are being substituted for acid ones, thereby suppressing slag formation, and attention is being paid to keeping coal ashes from blowing over from the firebox, so that a true melting without refining is being approached. It is well known that cathode copper when drawn into wire will show an electrical conductivity some two per cent. higher than the same copper after a subsequent fire refining. This is probably due partly to the fact that chemical impurities in the cathode are chiefly present as a mechanical mixture due to adherence of anode slimes which are dissolved in the copper when melted, making a high resistance matrix around the copper crystals when the metal is cast and cooled; and partly to contamination during melting. It seems probable that the conductivity of perfectly pure soft copper is in the neighborhood of 103 per cent. of the Matthiessen standard in common use.

Lake ores are low grade native copper deposits, which are mechanically concentrated to an 85 per cent. mineral. This is melted and, after skimming off the slag formed by the remaining gangue, is given a fire refining as previously described. The Michigan mines are among the oldest, largest and deepest in the world. Thirty years ago Lake copper was the standard of the industry. The surface ores were remarkably free from objectionable impurities and copper of the highest conductivity was readily produced. The first electrolytic copper to come on the market was of irregular character due to lack of familiarity with the principles of this new process and for a considerable time Lake copper was deservedly considered superior. With increasing depth, however, many of the mines showed increasing quantities of arsenic and indeed all Lake copper may be considered as arsenical copper, although in some brands the arsenic is very low. The result was that electrolytic copper began to take precedence for electrical work, as its conductivity could be absolutely depended upon, and Lake began to fall back upon superior "working" qualities, a term which defied exact definition.

It is now generally admitted that high conductivity Lake copper cannot be distinguished from electrolytic copper, while low conductivity Lake is really an alloy of copper with arsenic which has certain desirable properties for special uses. Nearly all the elements which markedly depress the conductivity when alloyed with copper are helpful in developing desirable mechanical properties, for example, phosphorus, aluminum, and silica. High arsenical copper running about 0.4 per cent. arsenic has now a special market for making firebox plates in Germany, and uses are beginning to be found for the intermediate grades. One of the large Lake companies maintains its own electrolytic refinery, and in this way recovers a small amount of silver and eliminates the arsenic, the product still being classed on the market as Lake, although it is equally electrolytic. The old prejudice in favor of Lake on general principles has now largely died out, but only with the contemporaneous retirement of the older generation of wire mill managers. Lake copper should be clearly graded by arsenic contents into a series of alloy coppers, the class at one end competing with electrolytic on its own ground, and the other classes sold in competition with arsenical copper from other sources, a field which has only lately been properly appreciated.

The last class of copper produced which we have to consider is that generally known as casting copper, a very loose term covering a multitude of sins. There are three main sources of casting copper (a) from converter bar or black copper from smelters whose ore supply carries quantities of silver and gold insufficient to pay for refining, (b) by-product copper not up to standard electrolytic grade occasionally produced by refineries and (c) the result of smelting scrap reclaimed from all sorts of new and old work. The first is often of excellent quality, one well known brand being maintained at 99. 80 per cent. Cu or better, and is generally comparable with English Best Selected. The second class is generally an arsenical copper and is not now often seen as the refineries are nowadays able to eliminate arsenic from the process in other ways. The third class is generally foul, but often suitable for common castings as the impurities help the founding, pure copper being a difficult metal to handle in a foundry. The copper contents may run below 99 per cent. Cu., however.

Specifications for Lake and electrolytic copper may be readily drawn and after a thorough investigation the American Society for Testing Materials has issued a set which should be generally accepted by engineers, as it has already been by the large refineries and wire mills. Casting copper presents a specification problem hopeless of solution at the present time, as there are well known brands in the market with the widest imaginable range of impurities, all of which are being kept consistently within a certain range of quality for each individual brand and which find a market for various special uses. About the one thing that can be said of casting copper is that neither a conductivity nor a ductility test is applicable in the nature of things.

THE USES OF COPPER.

Turning now to the uses for copper, they may be broadly classified as follows: (a) wire and other shapes for electrical purposes; (b) sheets and plates for non-electrical uses; (c) copper castings, generally for electrical use; (d) in alloys such as brass and bronze; (e) special purposes for which small quantities of alloyed impurities may be advantageous.

Electrical use immediately imposes a conductivity requirement which rules out everything but electrolytic and high conductivity Lake, which, as before stated, are practically identical coppers. Most of the electrolytic refineries figure on averaging about 100.0 per cent. soft in the electrical conductivity of their outputs. Occasional lots may reach nearly to 101.0 per cent. and some may approach 99.0 per cent., while 98.5 per cent. is the usual rejection limit, but it is very unusual for a refinery to ship anything for electrical use which is below 99.0 per cent. No distinction is made between cakes, wirebars and ingots, more than one shape often being cast from a single furnace charge, so that there is nothing to be gained by ordering wirebars and then cutting them up, when ingots are desired.

Unless electrical use is specified it is customary to allow an additional leeway of one per cent. in conductivity to the refiner, but he rarely needs this and prefers to maintain the higher standard, as copper is often resold several times before it comes into the hands of the actual user. As copper from a single furnace charge will carry practically uniform chemical inpurities, shipments on an individual order should be filled from as few furnace charges as possible and all wire bars and cakes should be stamped with marks identifying these charges. The refiner will always consider complaints on a furnace charge basis if they are of a chemical nature. If they are indefinite he will generally investigate what other customers received copper from the charge complained of, and in the absence of other complaints will demand a bill of particulars before giving the matter serious consideration. The con-

ductivity of a furnace charge is generally determined at the refinery several times while the charge is being cast and this precaution together with the ample margin above rejection limits which is maintained have practically abolished conductivity complaints.

EFFECTS OF IMPURITIES.

When copper is not to be put to an electrical use conductivity is of no special value except as a certificate of the absence of more than a trace of a certain class of impurities. The refiner divides impurities into three classes; those that depress conductivity, such as arsenic and antimony; those that impair ductility, such as lead, tellurium and bismuth; and those which are of value if reclaimed, such as silver, gold, platinum and palladium. The elements which depress conductivity are kept within bounds by the conductivity test regularly made. Those which are of value if reclaimed will never reach quantities sufficient to affect the physical properties of the copper as it would pay to re-refine any such copper. The remaining class comprising elements which impair ductility is more difficult to deal with. We know that bismuth, lead, tellurium and probably selenium make copper very brittle even when present in very small quantities. We do not know, however, how to write a specification limiting these impurities as the presence of small amounts of other impurities will neutralize their bad effects. We do know that amounts of lead up to 0.005 per cent. have no perceptible effect in mill practice or in alloys. Double this amount shows mild effects. Lead is about the only one of the group ever met with in sufficient quantity to be of interest. As these elements are practically insoluble in copper their effect on the conductivity is directly proportional to the amount present and consequently negligible.

It must be understood that an element like lead is always present in small amounts in refined copper and the mere fact of its presence as shown by a delicate qualitative test is no basis for complaint. It should be further borne in mind that the determination of the small quantities of impurities in refined copper quantitatively can only be done with even reasonable accuracy by a chemist who has had large experience in this particular work. A representative analysis of refined electrolytic copper would be somewhat as follows:

Conductivity (annealed)	100.0 %
Copper	99.93000%
Silver	0.00100%
Gold	0.00001%
Sulphur	0.00300%
Oxygen	0.04000%
Iron	0.00350%
Nickel	0.00400%
Arsenic	0.00200%
Antimony	0.00300%
Aluminum	0.00100%
Phosphorus	Trace
Lead	0.00200%
Bismuth	Trace
Selenium	0.00050%
Tellurium	0.00050%
	99.99051%

It will be seen that oxygen is the chief impurity. It has been pretty conclusively shown that too much oxygen makes the copper harder and affects the annealing temperature, the tensile strength of wire and the number of breaks in a wire machine. This may be due to some surface effect as the "set" surface of a wire bar has a greater oxygen content than the body of the bar and as the oxygen content increases it is possible that this oxidized layer becomes thicker. Another point about high oxygen is that it corresponds to low copper contents and to that extent is sold as copper. In brass making the "set" or "pitch" of the ingot is of no consequence except when the most careful work is done when melting in the foundry to avoid further absorption of oxygen. It is obviously useless to impose rigid conditions upon the refiner if the same conditions are not observed in the remelting and it is only at the largest and best equipped brass foundries that such conditions are even approached. When zinc is introduced into molten copper it acts as a deoxidizing agent forming zinc oxide. If the copper is kept at very high pitch this source of zinc loss and dirty brass can be greatly diminished and this fact has resulted in a demand for high copper contents in ingots.

It has therefore become a general custom to specify that the copper contents of refined copper shall not be less than 99.88 per cent., which really means 99.90 per cent., allowing 0.02 per cent. for assay variations. As this is a rejection point the actual average content is expected to be between 99.92 and 99.94 per cent.

When we come to casting copper a far greater leeway must be allowed as already pointed out. In fact, except in considering the price charged for the material, copper contents has but little to do with casting copper. It is best to buy this material on the basis of known brands after finding what brands yield good results in the particular class of work and then insist upon uniform deliveries, judging the material by chemical analysis of the chief impurities.

PHYSICAL DEFECTS OF COPPER.

The physical defects of refined copper are many. Practically all cast copper is porous, doubtless due to the discharge of dissolved gases as the copper cools.

This is analogous to the "piping" of steel ingots, but is not so pronounced because copper is cast in a shallow mold instead of on end. These microscopic bubbles are doubtless the cause of roughness in wire. Then there is a class of defects inseparable from ladling, consisting of cold sets and splashes where the copper has run up on the mold and chilled before the main body of metal reaches that point. Then there is porosity or sponginess of the surface due to the mold being either too hot or too cold. Another defect is raised edges on the set surface, generally due to slightly lowered pitch corresponding to excessive oxygen content of the copper. Should the pitch drop still lower "nigger heads" or little black spots will appear. These are the outlets of gas cavities extending some distance into the copper. On the other hand, should the oxygen content be too low the surface of the bar rises and finally breaks open or "spews," an even worse condition.

Many of these defects are always present in more or less degree. Mechanically ladled copper can never be perfect. Specifications require that copper shall be free from mechanical defects, but a reasonable attitude regarding minor troubles on individual pieces is generally necessary to the peace of mind of a buyer. On the other hand, a refinery occasionally becomes careless in such matters and will send out some surprisingly bad work, so that careful systematic inspection combined with an attitude of friendly criticism is the best way for a copper producer and a copper user to live together.

GOLD AND COPPER OUTPUT OF RUSSIA.

The amount of "schlich" gold (pounded gold ore) obtained in the Amur district in 1913 was 2,528 troy pounds.

The production of copper in Russia during the first four months of 1914 amounted to 11,667 short tons, against 13,009 short tons in the corresponding period of 1913. The reduction is said to be connected with the re-equipped of several of the works.

THE ART OF METAL SPINNING

THE SPINNING OR FORMING OF METALS TOGETHER WITH THE TYPE OF TOOLS, CHUCKS AND LATHE REQUIRED TO PRODUCE THE ARTICLES FROM THE METAL BLANKS.

BY EASY WAY.

(Continued from August.)

INTRICATE METAL SPINNING.

The spinning of metal into cylindrical shapes has been mastered successfully, but it involves a great deal of practice and perseverance that of turning the outer portions of circular blanks that are being spun through an angle of ninety degrees and which compresses very materially the metal as its outer portion. In addition to this that of producing sharp corners between the bottom and sides of the cylindrical shape is also an arduous task. Nevertheless an experienced workman does both of these and with apparent ease. It is always necessary to do some "spinning in the air," otherwise the supporting stick would not be required at all.

Some estimate the relative amount of spinning that may be accomplished on each block when an intricate shape is contemplated and divide the operations intelligently; generally annealing the metal after being spun and taking it from one of the primary chucks and placing it on the finishing chucks. In this manner, if the total amount of articles is a large quantity, as many lathes as there are operations can be made use of and facilitate

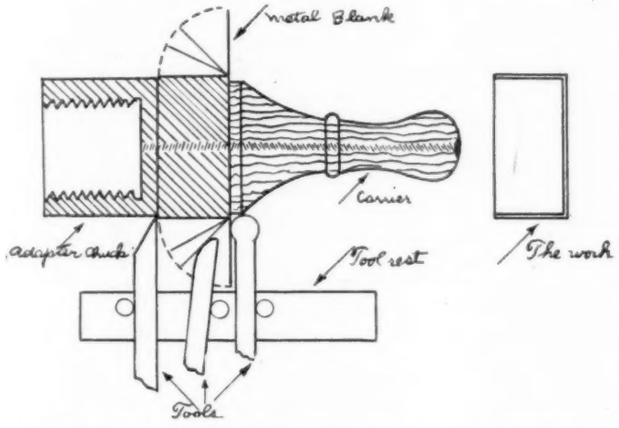

FIG. 8. SHOWING METHOD FOR HOLDING AND DRIVING ARTICLES TO BE SPUN.

holding the job up, so to speak, if it is wanted in a hurry. Many articles when finished have a hole in them at the center, as, for instance, a metal top for bottles, etc. This hole can be used conveniently when spinning the article, it being governed by a binder which acts as a driver and holds the blank in position on the chuck (see Fig. 8). As will be noted in the sketch this method differs from the former ways of holding and driving the articles to be spun. The reducing nozzle can be used inasmuch as bottle tops are generally of small diameter and the form chuck produced of metal or wood. Then after the form is turned to shape and a hole drilled through the center a threaded steel rod that is fastened permanently in a hard wood handle is inserted through the hole in the piece to be spun and the form chuck then screwed tight into the tapped hole in the reducing nozzle or chuck, thus holding the article substantial against the chuck face while working. After this has been accomplished start the lathe in motion and place the tool rest in position, its height being such that when the spinning tool is placed on it, the knob of the tool will be on a line with the lathe center. Then lubricate the article to be spun with heavy oil or tallow while rotating. Next, place the tool against the pin in the tool rest and with the left hand hold a wedged shape piece of hard wood against the back of the blank and press the tool firmly, but at first gently, to the right and as the tool rest pin serves as a fulcrum the metal will give way and begin to take shape. The action of the tool describes an arc of a circle with the rest pin as the center and with the metal rotating between the knob on the tool and the wood in the left hand. When the arc is completed the flat will have changed to the shape shown in the sketch, then by changing the position of the pin and repeating the operation the blank is brought closer to the form. The next operation is to remove the ragged edge with a diamond point tool, then bring the metal down close to the form and with a bead tool press the metal firmly and smoothly against the form until all bulging and wrinkles have disappeared. Now remove the handle with the threaded steel rod, restart the lathe in motion and oil the front face of the blank where it is concealed by the handle and apply the same bead tool at the lowest edge and moving it toward the center, at the same time pressing hard against the form. By so doing obtain the sharp angle and finishing the metal. Whenever turning or trimming small articles always draw the tool rest a little away from the work and rest the fingers of the left hand with their insides upwards on the tool rest, making the three fingers a rest for the tool. With the tool in the right hand advance the cutting edge of the tool to the metal and practice a fine shaving.

The way the tool is held insures delicacy of touch and by advancing the cutting edge of the tool obliquely against the articles surface an excessively fine continuous shaving is removed and insures a bright finished surface. Some, however, use crocus cloth or fine emery to produce a finish on brass and German silver, but the proficient artisan never does as he relies solely upon his tools that are in proper condition and will not produce scratches and gullies in the work. As all turning of metal is accomplished in the same manner further explanation is not really necessary. Copper is very seldom turned otherwise than trimming, therefore, shapes made from this metal are spun smoothly as possible and afterwards finished with fine emery cloth.

To produce an article from a blank with sharp corners and curled edges without any holes can be produced, as shown in Fig. 9, and which is described in the following explanation.

As the blank has no hole at its center a rig, as shown, is used. A block center with a steel insert that fits tight in the center of the block and the insert with a conical hole to admit the tail stock center. After the form is finished to the required shape, place the block center on the tail stock center and reduce its diameter a trifle less than that of the form; then place the metal blank between the form and block centrally and tighten the tail stock center to the steel insert. A drop of oil in the conical hole of the insert is necessary to insure its rotating smoothly on the tail stock center. Then proceed to produce the shape on the form as shown. To force the metal home and procure a sharp corner use a shape tool, as shown in Fig. 9, and in the manner shown. The force required for a sharp corner tends to harden the metal

and the article should always be annealed at the time of the operation, then after the corner and shape has been conformed the outer edge of the blank is trimmed and its edge ready for curling by the aid of the spinners beading tool, otherwise known as spinners pliers. These should be kept well lubricated because of the metal slipping between the jaws. As the metal rotates move the

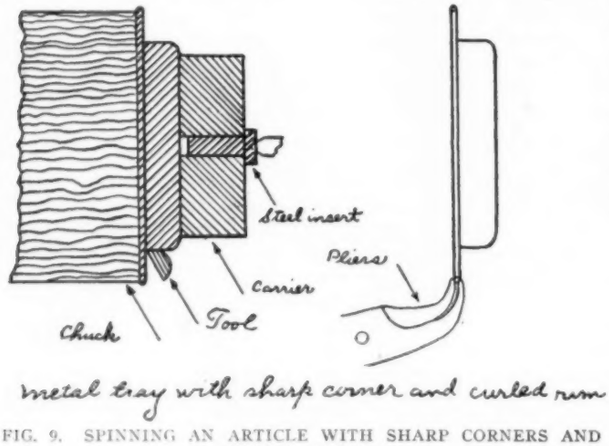

FIG. 9. SPINNING AN ARTICLE WITH SHARP CORNERS AND CURLED EDGES.

pliers steadily through a quarter of a circle until the edge of the metal assumes the shape shown, then finish the bead with a staff and bead tool, round not flat, and which serves as an ornament to break the monotony of the surface and blend with the remaining shape which now resembles a metal tray.

SECTIONAL OR SPLIT CHUCKS.

As we have now advanced quite sufficiently to undertake more intricate shaped articles the sectional or split chucks will next be considered and illustrated. The work as a whole is far more difficult that the simpler methods passed, because of necks, grooves, beads and other ornamental shapes, also the top of an article being smaller in diameter than the bottom requires preliminary and intermediate chucks. As these chucks are produced in sections and finished on a master cone, it becomes necessary

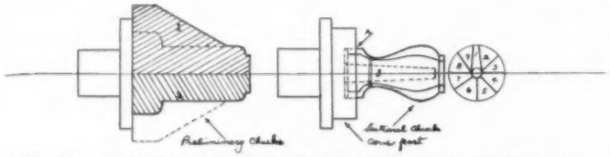

FIG. 10. SHOWING METHOD FOR MARKING A SECTIONAL CHUCK.

to stamp with figures their respective position on the master, as shown in Fig. 10. There was a time when hollow ware, such as urns, etc., of uneven contour were spun on solid forms and after the article was finished the form of wood was bored out with tools or burned from the object which was usually damaged by this method and which was very difficult to accomplish successfully. It then became necessary to devise better ways and promote the evolution of the art of spinning, thus the advent of the sectional chuck. These chucks are constructed with a key piece which will allow the remaining parts of the chuck to loosen when it is withdrawn and the remaining parts dismantled without the slightest annoyance. When they are removed from the spun article they are then reassembled on the master cone with ease, as all parts are stamped, and when locked with the key are ready for the next blank. When preparing a construction for the sectional chuck select carefully a well-seasoned piece of hard wood with straight grain and not liable to shrink perceptibly. As an illustration at this time dogwood is chosen to produce an urn shape with a small neck at the top.

First, procure a taper reamer to prepare the hole in the chuck that it may be properly fitted to the master cone, then bore and ream the wood block and turn a diameter on it about a half inch long which will later be fitted to the cone at A (see Fig. 10). Next produce the cone and accurately fit the hole and the turned diameter to it, after which the finished shape of the urn is produced on the block by aid of a templet. The form now shaped is removed from the cone and split into sections and stamped so that all parts except one taper toward the center of the form. The part stamped "one" is the key piece and should be made large at the center and small on the outside of the form. Judgment and precision should be practiced when sectioning the form that the key piece may be removed first through the hole bored for the cone, then all the others may be withdrawn if not sectioned too thick. This accomplished a sectional chuck has been produced and when assembled on the cone in the order stamped, is ready for the metal to be spun on it. The ends fitting the recess bored in the cone part and the cone in the hole of the chuck warrants it not running out of true, if the cone is not disturbed on the face plate. The other two chucks shown are the preliminary forms marked No. 1 and No. 2. A little difficulty may be experienced when starting the spinning on form No. 2, as spinning in the air is necessary and a compression of the metal required. However, if the base of the urn fits No. 2 chuck as well as No. 1 and the tail stock spindle is properly adjusted there should be no buckling at the base, and the metal being pliable the required amount of compression can be accomplished and produce the cylindrical shape on No. 2 form with care.

(To be continued.)

NEW USES FOR QUICKSILVER.

The quicksilver production of the world during 1913 is estimated at 4,171 metric tons, against 4,262 tons in 1912 and 4,083 tons in 1911. The countries of production last year were: United States, 688 tons; Austria-Hungary, 855 tons; Italy, 988 tons; Spain, 1,490 tons; Mexico and others, 150 tons. These figures were gathered by the United States Geological Survey.

Quicksilver is used mainly in the manufacture of fulminate for explosive caps, of drugs, of electric appliances and scientific apparatus, and in the recovery of precious metals, especially gold, by amalgamation. A new use in Scotland is the floating of lights of lighthouses upon a body of quicksilver. A use in England, in the United States, and possibly elsewhere is the coating of ships' bottoms with a paint containing quicksilver to prevent organic growth. Mercuric oxide (red oxide of mercury) is the active poison in anti-fouling paint successfully used on ship's bottoms. The metal appears to be but little employed in silvering mirrors, as nitrate of silver is now chiefly used for the purpose. Increasing use of quicksilver is probably to be expected in the manufacture of electrical appliances and of fulminates, and possibly of paints for protective coatings on metals. The demand for quicksilver for amalgamating gold and silver has greatly decreased, as is well known, with the decreased supply of free milling ores and the increased application of cyanidation to gold and silver ores. Industrial chemistry and inventive genius are to be looked to for increasing the demand.

BRINNELL HARDNESS TESTING OF NON-FERROUS ALLOYS*

A DESCRIPTION OF PHYSICAL TESTS RECENTLY APPLIED TO COPPER ALLOYS

By V. Skillman.†

Among the more important physical tests to which non-ferrous alloys are submitted there is one which, until recently, has received comparatively little commercial application. Although the hardness of a metal is often of considerable importance to both the manufacturer and engineer, it is usually classified by saying that it is hard or soft without reference to any definite method of measuring that quality. Naturally the result depends much upon the personal view of the observer. If the machinist classifies an alloy as hard, the engineer will quite likely find its resistance to compression or indentation is not such as would lead him to call it hard.

Considerable of the confusion is the result of the difficulty in defining hardness. It seems at present impossible to use any scientific unit to express hardness and quite different meanings are embraced by the one general term. As the result of such a condition the methods devised for measuring hardness have been the outgrowths of attempts to obtain data with some particular idea in view in each case. The numerals found are, therefore, empirical and depend upon the method used in their determination. One of the oldest methods of determining hardness is to ascertain the amount of resistance to scratching. This is the method of the mineralogists. Means have also been devised for its application to metals.

Other methods measure the compressive hardness by determining the resistance offered to indentation by another body. A measurement of the elasticity is made use of in some methods, while in others toughness and abrasive qualities are brought into prominence in determining the cutting hardness.

Of the many methods developed, several have lately come into prominence on account of the possibility of their commercial application. One of the most used is that devised by Brinell. It is dependent upon the resistance offered by the sample to indentation. The test consists of pressing a hardened steel ball into the surface of the sample being investigated by means of a definite load and measuring the diameter of the resulting indentation. The hardness numeral is the ratio of the pressure on the sphere to the area of the spherical indentation. The numeral may be readily calculated from the following formula:

$$H \frac{L}{\frac{\pi D}{2}(D - \sqrt{D^2 - d^2})}$$

in which L is the load expressed in kilograms, D the diameter of the ball in millimeters, and d that of the ball impression in millimeters. Or it may be more easily determined by referring to one of the tables published in many engineering hand-books.

The test can be made in any form of apparatus capable of pressing the ball upon the surface of the metal and measuring the pressure exerted. One of the most popular machines for non-ferrous work is that manufactured by Aktiebolaget Alpha, of Stockholm, Sweden, which has the advantage over most other appliances for making the Brinell test in that loads of 500 kilograms may be used as well as the 3,000 kilogram load, which is applicable mostly to steel.

In the absence of a special piece of apparatus the test may be made with considerable accuracy in the average small size tension-compression testing machine. The machine is arranged as for a compression test, and the steel ball is fastened to the under side of the pulling head as near the center as possible. It is better if it is not fastened to hardened steel, as it will more readily form a seat for itself on making the first impression. No elaborate device is necessary to hold the ball if the specimens to be tested are mounted fairly level as they should be. A piece of tar or similar material is all that is required to hold the ball in place.

The test is best made by first bringing the ball just in contact with the face of the specimen. The weight on the machine is then run out to a hundred pounds or so less than the load finally desired. Pressure is next applied until the beam floats, using one of the higher loading speeds. The weight is quickly advanced and set accurately at the full load to be applied. The slow speed of the machine is then used to float the beam, and keep it floating during the time required for the test.

It is probably sufficiently accurate to figure the time, which the piece is subjected to pressure as beginning when the beam first rises as the greater part of the load is then operative. After 30 seconds, or 15 seconds if the 3,000 kg. is being used, the pressure is released and the diameter of the indentation measured in millimeters. It has been found that after a little practice with a fairly sensitive testing machine results can be obtained which check very well with determinations made on the Alpha apparatus.

STANDARD METHODS.

In making the Brinell test it is exceedingly important that what may be recognized as a standard set of conditions be followed. Most of the data so far published has referred to ferrous material. Much of that which has been obtained on non-ferrous alloys would often have been of more general value and application if the conditions suggested by Brinell had been followed in making the tests.

It has been recommended that a standard ball of 10 mm. diameter be used with loads of 3,000 kilograms for ferrous materials and 500 kilograms for non-ferrous alloys. It is also advised that iron and steel samples be submitted to the pressure for 15 seconds and alloys for about 30 seconds. Much published data will be found in which one or more of the above conditions has been varied. Such information has probably served its purpose admirably as far as the work is concerned in connection with which it was published, but it would have been of more general use if standard conditions had been followed rendering it directly comparable with other data. At times no statement at all is made regarding the conditions of the test and as standard methods have quite likely not been followed the data is almost worthless for comparative use.

The factor which has the greatest influence on the numeral obtained is the pressure applied. It has been found that elastic deformation of the sphere used is produced by the load. It is relatively greatest at the lowest pressures. Under such loads the indentation is small and the resistance offered is all in the direct line of the pressure applied. There is practically no lateral component tending to make the sphere retain its shape as when heavier loads are applied and the indentation is likely to be greater.

If the depth rather than the diameter of the indentation

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†Lumen Bearing Company, Buffalo, N. Y.

produced were measured, the size of the load would not be of as much consequence. It is quite likely that a linear relation exists between depth of indentation and load. It is, however, more difficult to measure the depth than the diameter of the indentation, and the latter is now almost exclusively the measurement made in commercial work. Under all conditions the radius of curvature of the indentation is greater than the radius of the sphere. The amount varies, however, depending upon the alloy. The following table gives the results of tests made with two different loads, each pair of determinations being made on the same sample. The hardness number was determined by reading the diameter of the impressions.

HARDNESS NUMERALS OBTAINED WITH DIFFERENT PRESSURES.

	How cast.	Hardness under 500 kg. load	Hardness under 3,000 kg. load.
Phosphor Bronze, 10 Sn.....	Chill	86	107
Phosphor Bronze, 20 Sn.....	Sand	158	196
Phosphor Bronze, 10 Sn 10 Pb	Sand	50	69
Phosphor Bronze, 10 Sn 10 Pb	Chill	80	103
Gun Bronze, 10 Sn 2 Zn.....	Sand	70	82
Gun Bronze, 10 Sn 2 Zn.....	Chill	86	107
Manganese Bronze	Sand	109	137
Manganese Bronze	Chill	119	143

The above figures illustrate the necessity of either following adopted standard methods of testing or stating the conditions under which the test was made and especially the load applied. The diameter of the ball used does not seem to affect the test very greatly, nor does a variation in the length of time the load is applied. It would seem preferable, however, especially in the absence of more detailed information concerning their effect on the test as applied to non-ferrous alloys, to follow standard methods.

Judging from the similarity of the compression and Brinell tests, it would appear that the length of time the load is applied would have some little influence on soft materials such as white metals and babbitts, which are inclined to flow under compression. It almost surely would if the load were applied for five minutes as directed in one recently published handbook, which gives directions for making the Brinell test.

TEST SAMPLES.

Besides the variables due to the manner of testing, there are also those introduced by the sample. The effect of casting conditions upon the tensile strengths of alloys is becoming quite well known. The hardness is effected by many of the same factors.

One of the most noticeable influences is the diminution of grain size due to chilling or to "skin effect," with a resulting increase in hardness. A large casting of red brass showed a hardness of 43 to 48 when tested inside a heavy section. The skin on a quarter inch thick section of the same casting had a hardness of 70 to 80.

As in the tensile test, chilling seems to have the most influence on the hardness in the Phosphor bronzes. These same alloys are decidedly influenced by the temperature of pouring and the resulting rapidity of solidification. A phosphor bronze containing 20 per cent tin gave a Brinell hardness of 100 to 109 when poured hot. The same pattern of test piece poured cold from the same pot of metal gave 158. Compression tests showed a permanent set of 0.070 of an inch per inch under a load of 100,000 pounds per square inch for the hot poured material and 0.024 of an inch per inch for the cold poured. Test bars cast to size and pulled without machining gave 23,800 pounds per square inch tensile strength for the former and 35,000 pounds per square inch for the latter. The Brinell test offers an excellent means of judging the quality of such material without going to the trouble of making compressive or tensile tests.

It is evident that the hardness of a certain alloy cannot always be expressed by one definite Brinell numeral. The best that can be said is that it usually has a hardness between certain limits depending much on the particular sample selected for test. It would be well if some standard form of test specimen could be agreed upon. The end of the cast to shape test bar has been found very convenient by the author for comparative work.

Some idea of the hardness of a few common brass foundry alloys may be gained from the following table. The determinations were made with a 10 mm. ball and a pressure of 500 kg. applied for 30 seconds. The sand cast data was obtained by using the ends of cast to shape test bars. The chill cast data is from sections of small ingots cast in an iron mold.

USUAL HARDNESS OF SOME COMMON ALLOYS.

Alloy	Hardness under 500 kg. cast in Sand	Chill
Phosphor Bronze, Cu 90 Sn 10.....	67-70	93-100
Phosphor Bronze, Cu 80 Sn 20.....	143-158	.....
Phosphor Bronze, Cu 80 Sn 10 Pb 10.	65-70	80-89
Gun Bronze, Cu 88 Sn 10 Zn 2.....	65-74	86-93
Composition, Cu 85 Sn 5 Pb 5 Zn 5...	48-59	63-67
Yellow Brass, Cu 69 Sn 1 Zn 30.....	54-59	59-65
White Brass, Sn 66.5 Zn 29 Cu 4.5....	19-20	22-23
S. A. E. Babbit, Sn 84 Sb 9 Cu 7.....	.....	26.5-30.5
Manganese Bronze	109-119	124-130

BRINELL AND SCLEROSCOPE READINGS.

The relation between Brinell and Scleroscope hardness determinations would often prove useful if it could be fairly accurately determined. It is at times stated that to change from the Brinell number to the Scleroscope reading, the former should be divided by six, and the Scleroscope number multiplied by six gives approximately the Brinell numeral.

Such directions may hold for ferrous material where loads of 3,000 kg. have been used for the Brinell tests and the universal hammer was used with the Scleroscope. They do not hold, however, for non-ferrous alloys tested under 500 kg. loads and with the magnifier hammer in the Scleroscope. Further, it does not seem likely that any one factor will be found to apply for all classes of non-ferrous alloys.

The hardness test is capable of considerably wider commercial application than it has so far received. Much useful information can be quickly gained by its aid, but in order to avoid confusion and possibly self-deception, it is necessary to be familiar with the more important conditions which influence the results. If some of these factors have been at least roughly set forth in this paper, its object will have been attained.

COPPER PRODUCTION IN JAPAN.

Copper is the most important mineral product of Japan. Its production has for many years been increasing in a steady ratio to the number and growing efficiency of the plants. The year 1913 was not favorable for copper mining, the prices throughout the world fluctuating so that producers were unable to foresee market conditions. Nevertheless the production of copper in Japan increased by 3,410 metric tons in 1913 over the previous record of 61,471 tons in 1912. The value of the copper production in 1912 was $20,045,526, and in 1913, $20,716,800. The greater part of the ore mined in Japan is smelted at the mines, and exports in 1912 and 1913 were less than $1,000.

THE MICRO-CHEMISTRY OF CORROSION*

By Samuel Whyte, B.Sc., and Cecil H. Desch, D.Sc., Ph.D.‡

Part II.—The α-Alloys of Copper and Zinc.†

The experiments described by the authors in Part I. of this investigation§ were confined to the β-solid solutions of the copper-zinc series, the original intention having been to examine the alloys of the Muntz metal class, containing both the α and β constituents. As the corrosion of such alloys begins always in the β-areas, it was thought advisable to investigate the micro-chemical nature of the process in this constituent first, before proceeding to the more complex case. This selection had the disadvantage that the alloys examined were of little technical importance, and any results obtaineed from the experiments could not be directly employed to establish any practical conclusions. In this second part the alloys dealt with are those which find the most important technical applications.

The use of an external electromotive force for the purpose of hastening corrosion undoubtedly introduces a factor which is not present in the ordinary conditions of unassisted chemical corrosion, but is unavoidable for the particular purpose which the authors have in view. Chemical corrosion is too slow and too irregular, too easily affected by accidental and uncontrollable changes in the conditions, to lend itself to investigation on the small scale in the laboratory for the purpose of obtaining quantitative data. Chemical corrosion is thus more satisfactorily studied by means of experiments on the large scale, continued over long periods, as in the elaborate series now in progress under the auspices of the corrosion committee of this institute.

Nevertheless, it appears that experiments on a small scale may throw some light on the *mechanism* of corrosion, even when it takes place under conditions excluding the presence of an external electromotive force. The comparison of laboratory experiments with observations of corroded specimens of copper-zinc alloys from works and shipyards has convinced the authors that all corrosion of these alloys is preceded by dezincification, but that where the action proceeds slowly, and there is free access of gaseous or dissolved oxygen, the spongy residue of copper may be converted into oxide as fast as it is formed. This, it is believed, is the origin of the adherent layer of copper oxide which is often found on the corroded surface of brass. The evidence for this view is given in the present paper.

The method of experiment employed was modified slightly in order to ensure greater accuracy, but was in all essentials the same as that described on p. 307 of the first paper. The cathode, instead of being a loop of platinum wire, was made of fine platinum gauze, 1 centimetre square, having a vertical platinum wire welded to it for the purpose of attachment to a support. The Classen stand for electrolytic analysis was found to be most convenient for holding the cathode in place, the distance between the surface of the specimen and the cathode being adjusted by interposing a sheet of plate glass 5 millimetres thick, and bringing the cathode gauze into contact with it, and then withdrawing the glass.

The analytical methods were the same as those described previously. Lead, which was not included in the earlier experiments, was removed from solution by electrolysis with a small platinum gauze anode, on which the lead was deposited as peroxide. This was then dissolved in a little nitric acid, evaporated to dryness, and dissolved in water. On the addition of 0.5 cubic centimetres of a solution of hydrogen sulphide, a yellow coloration was produced, which was compared in an Eggertz tube with that given under the same conditions by a standard solution of lead nitrate. No special difficulties were encountered in the course of the analytical work.

Record of Experiments.

In this series of experiments four alloys were used, one of which was examined in the annealed and also in the unannealed condition. The analyses are given in Table IX. The figures in the last two columns give the composition of the equivalent copper-zinc alloys, determined by Guillet's method, the coefficients of equivalence of tin and lead being taken as 2 and 1 respectively.

Alloys.	Copper, per Cent.	Zinc, per Cent.	Tin, per Cent.	Lead, per Cent.	Fictitious Values by Guillet's Formula. Copper, per Cent.	Zinc, per Cent.
I. and II.....	69.88	30.12	...	...	69.88	30.12
III.....	69.89	29.03	1.08	...	69.15	30.85
IV.....	70.15	28.85	...	1.00	70.15	29.85
V.....	69.90	28.11	...	1.99	69.90	30.10

The "fictitious values" for zinc and copper represent the composition of the pure copper-zinc alloy which would correspond most closely with the actual ternary alloy.

In the first series of experiments the application of the current was continued for five minutes, the products being analyzed immediately afterwards. Alloys I. and II. contain copper and zinc only, I. being unannealed and II. annealed at 800 degs. C. for two hours, while III. contains tin, and IV. and V. contain lead. The results of these tests are shown in Tables X., XI. and XII. By "precipitate" is meant the flocculent precipitate of basic salts which appears in the electrolyte, and is readily separated from the specimen, while "adherent layer" denotes the metallic deposit which was mixed with zinc oxychloride in the cases of Alloys I., II., IV. and V., and with tin oxychloride in the case of Alloy III. This deposit could not be flaked off as with the "β" alloys, this being probably due to the increased amount of basic salts, which seemed to be intimately mixed with the cop-

Table X.—Composition of Precipitate.
Time, 5 minutes.

Alloy.	Copper, Mgms.	Zinc, Mgms.	Tin, Mgms.	Lead, Mgms.	Total, Mgms.	Copper, per Cent.	Zinc, per Cent.	Tin, per Cent.	Lead, per Cent.
I.	0.90	0.95	....	....	1.85	48.6	51.4	....	....
	0.95	1.00	....	....	1.95	48.7	51.3	....	....
II.	1.05	0.95	....	....	2.00	52.5	47.5	....	....
	1.00	0.91	....	....	1.91	52.3	47.7	....	....
III.	0.30	1.22	none	....	1.52	19.7	80.3	....	....
	0.32	1.08	none	....	1.40	22.8	77.2	....	....
IV.	1.25	1.26	....	none	2.51	49.7	50.3	....	....
	1.20	1.07	....	none	2.27	52.8	47.2	....	....
V.	0.60	0.60	....	none	1.20	50.0	50.0	....	....
	0.60	0.57	....	none	1.17	51.3	48.7	....	....

*Paper read at annual meeting of Institute of Metals held at Westminster, London, S.W., March 17, 1914.

†Part I of this paper published in The Metal Industry, October, 1913, and March, 1914.

‡Respectively Assistant and Graham Young Lecturer in Metallurgical Chemistry in the University of Glasgow.

§Journal of the Institute of Metals, No. 2, 1913, vol. x, p. 303.

TABLE XI.—Composition of Adherent Layer.
Time, 5 minutes.

Alloy.	Copper, Mgms.	Zinc, Mgms.	Tin, Mgms.	Lead, Mgms.	Total, Mgms.	Copper, per Cent.	Zinc, per Cent.	Tin, per Cent.	Lead, per Cent.
I.	0.425	0.331	....	....	0.756	56.2	43.8	....	....
	0.45	0.315	....	....	0.765	58.8	41.2	....	....
II.	0.40	0.25	....	....	0.65	61.6	38.4	....	....
	0.375	0.20	....	....	0.575	65.2	34.8	....	....
III.	2.35	0.13	0.03	....	2.51	93.6	5.2	1.2	....
	2.40	0.31	0.03	....	2.74	87.6	11.3	1.1	....
IV.	0.80	0.13	....	none	0.93	86.0	14.0	....	....
	0.83	0.20	....	none	1.03	80.6	19.4	....	....
V.	0.86	0.24	....	none	1.10	78.1	21.9	....	....
	0.86	0.25	....	none	1.11	77.4	22.6	....	....

TABLE XII.—Total Weight of Corrosion Product.
Time, 5 minutes.

Alloy	I.....	2.62 and 2.71	milligrammes.
"	II.....	2.65 " 2.49	"
"	III.....	4.03 " 4.14	"
"	IV.....	3.44 " 3.30	"
"	V.....	2.30 " 2.28	"

pery deposit from the surface to its junction with the brass beneath. If these basic salts were removed by a very dilute solution of hydrochloric acid (one drop in 30 cubic centimetres of water), there remained an adherent layer of coppery crystals. This layer was much more difficult to detach from the brass than that which was produced in the corrosion of the β-alloys, but, as in the former experiments, a perfectly sharp boundary between the brass and the dezincified layer was always present. In the second series of experiments 100 cubic centimetres of the electrolyte were allowed to flow over the surface during a period of sixty minutes. (Table XIII.)

The total weight of the corrosion product, including both the precipitate and the adherent layer, is given in Table XII. (five-minute tests).

MICROSCOPICAL OBSERVATONS.

The Alloy I., containing copper and zinc only, had a very distinctly cored structure when examined in the cast condition, the appearance under the microscopic being characteristic of an α-solid solution in a state of imperfect equilibrium. Annealing for two hours at 800 degs. rendered the alloy perfectly homogeneous. A specimen was also examined in this state, and appears in the tables as Alloy II. Alloy III., containing tin (1.08 per cent.), was also heterogeneous in the cast condition, showing distinct segregation of the copper-tin constituent at the boundaries of the crystals. This constituent disappeared on annealing, and this and the remaining alloys were only employed for the corrosion tests in the annealed condition. Alloy IV. did not become completely homogeneous on annealing, but small isolated areas of lead remained undissolved here and there, while Alloy V., with twice the quantity of lead, showed well-defined bands of segregated lead at the boundaries of many of the crystals.

The behavior of the alloys on corrosion was characteristic, and strikingly different from that of the β-alloys. This was specially noticeable in regard to the film of copper left after dezincification. This was always intimately mixed with basic salts, which adhered very firmly, and, having a dull surface with low reflecting power, made it difficult to obtain satisfactory photographs. Momentary immersion in very dilute hydrochloric acid removed the greater part of the oxychloride, exposing the coppery layer, which was invariably made up to small crystals, mainly exhibiting octahedral angles. In the long-period tests etch-figures were conspicuously developed, cubic forms being frequently observed. Plate I., Fig. 1, taken from Alloy I., shows this effect, the cubic angles being well seen surrounding a rather deep etching-pit on the left.

Fig. 2, taken from Alloy III., shows the general appearance of the surface after detaching the film of copper. The crystal boundaries have been revealed by the corrosion, and the difference of orientation in neighboring grains is perceptible, but is somewhat less conspicuous than in the β-alloys under similar conditions. The black area in this photograph represents a firmly adherent layer of oxchlorides, covering one or more crystal grains. The cored structure of the unannealed specimen, Alloy I., was strongly developed during corrosion, finally leaving ridges in high relief, while the annealed alloys corroded very uniformly.

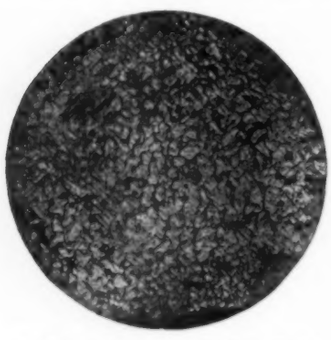


Fig. 1.—Alloy 1. One-Hour Test.
Etch Figures. Magnified 200 diameters.

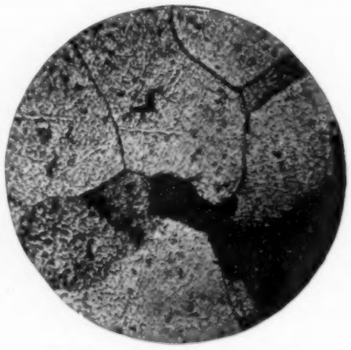


Fig. 2.—Alloy III. Coppery layer removed. Magnified 45 diameters.

Fig. 3.—Alloy V.
Etch Figures. Magnified 200 diameters.

The effect of lead was remarkable. On clearing off the adherent layer from Alloys IV. and V., each isolated mass of lead was seen to be surrounded by a ring of copper. Octahedral etch figures were strongly developed, as is shown in Fig. 3.

TABLE XIII.—Composition of Precipitate.
Time, 60 minutes.

Alloy.	Copper, Mgms.	Zinc, Mgms.	Tin, Mgms.	Lead, Mgms.	Total, Mgms.	Copper, per Cent.	Zinc, per Cent.	Tin, per Cent.	Lead, per Cent.
I.	8.00	5.67	....	....	13.67	58.5	41.5	....	....
	8.00	5.60	....	....	13.60	58.8	41.2	....	....
II.	8.50	5.35	....	....	13.85	61.3	38.7	....	....
	8.40	5.30	....	....	13.70	61.3	38.7	....	....
III.	1.20	7.18	trace	....	8.38	14.3	85.7	....	....
	1.20	7.68	trace	....	8.88	13.5	86.5	....	....
IV.	6.00	4.54	....	none	10.54	56.9	43.1	....	....
	6.20	4.60	....	none	10.80	57.4	42.6	....	....
V.	5.00	4.09	....	none	9.09	55.0	45.0	....	....
	5.04	4.09	....	none	9.13	55.2	44.8	....	....

(To be continued.)

CHEMICAL REACTIONS IN ELECTRO-PLATING

A Word in Favor of Sodium Bisulphite in Cyanide Plating Solutions.

By Frank Ottman.

Advocates of novel plating compounds delight in pointing to the use of bisulphite of sodium in cyanide plating solutions as irrational: "It decomposes the cyanide and only fills the solution with an inactive salt." Striving to pick up the rudiments of chemistry, the plater knows that the prefix "bi" in the denomination of a salt means an acid salt, part salt and part acid, the same as if the salt and the acid were used pro rata separately. He also knows from cutting down old silver solutions, that acid destroys the cyanide and returns the silver cyanide or chloride, which had been dissolved in the cyanide. So the argument appears quite plausible to him, although experience tells him otherwise.

Actually, the sulphurous acid and its salts, the sulphites and bisulphites, do not destroy nor counteract the cyanide, they increase its solvent capacity upon copper, and the plater might as well use straight sulphurous acid instead of a salt thereof without any harm to his solutions. Copper exists in two conditions, monovalent in cuprous compounds, and divalent in cupric compounds; hydrocyanic acid and its salts are monovalent. Hence, to saturate one atom of cuprous copper one molecule of hydrocyanic acid or its acid radical, cyanyl, CN or Cy, is sufficient; for the formation of cupric cyanide two molecules are required to every atom of cupric copper, or twice the amount of hydrocyanic acid or a cyanide. From the formation of cyanide of copper in a cupric solution usually a more complex compound results, cuproso-cupric cyanide, $Cu_2Cy_2.CuCy_2$, which requires one and one-third as much cyanide as the cuprous cyanide, Cu_2Cy_2, for the same amount of copper. Usually sulphate or carbonate of copper is employed for the production of a cyanide copper solution; in either the copper is divalent, cupric, and even if a cuprous compound were employed, it would soon change to the cupric state in contact with the air, and the product with cyanide would remain the same, cuproso-cupric cyanide, which, with more cyanide, enters into the soluble copper-alkali cyanide combination. Gradually, upon standing for some time, the $Cu_2Cy_2.CuCy_2$ changes to Cu_2Cy_2, setting free one-fourth of the cyanide, originally engaged, for further action upon another portion of copper. A moderate excess of copper carbonate, added to a solution of cyanide and at first appearing insoluble, will be found dissolved the next day. Heating accelerates the transformation quite readily, and for this reason a warm solution gives better results than a cold one, the proportion of cyanide present being the same and low. Here is now the point, where the sulphurous acid, sulphites or bisulphites come into action. They are reducing agents; they reduce the copper from the cupric to the cuprous state and thus prevent the formation of the cuproso-cupric cyanide entirely, with the result, that cuprous cyanide forms directly and immediately, and without the aid of heat. The advantage is apparent: The same amount of cyanide present in a solution which, in absence of a reducing agent, would take up three parts of copper from the anodes, dissolves and transmits to the cathode four parts, or 33⅓ per cent. more, of copper with the assistance of the bisulphite of soda, or the amount of cyanide can be kept 25 per cent. lower without impairing the efficiency of the solution, and the anodes retain their bright metallic surface just the same.

Like all reducing agents, the sulphites tend to undergo oxidation and will not remain in an active form infinitely, hence frequent additions of small amounts of bisulphite are more serviceable than the addition of a large quantity all at once. It must also be understood, that the advantage of the use of bisulphite is confined to its action upon the copper in the solution and anodes. Zinc, for instance, is strictly divalent, and no benefit can be derived from the use of a reducing agent for this metal; ammonia and its salts are the factor, which facilitates the dissolving of the zinc from the anodes. Silver is strictly monovalent, and a reducing agent would be out of place in a silver solution also. Hyposulphite (thiosulphate) of soda, which, on account of a similarity in the denomination, is often mistaken for the bisulphite in unintelligently copied formulae, is a solvent for silver like the cyanide, forming a soluble double thiosulphate of silver and the alkali analogous to the double cyanide. Both being equally subject, however, to gradual deterioration in contact with air, there is no benefit derived from the substitution of one for the other in a plating solution. Gold appears monovalent and trivalent, in both conditions forming soluble alkali-gold cyanides; a reducing agent will act upon it in the same way as with copper.

The other objection, that the addition of compounds like sodium bisulphite to cyanide solutions, even if their advantage were not disputed, will gradually charge the solution through their after-products with inert salts that reduce the solvent capacity for the primarily needed metallic salts, does not appear decisive either. A certain resistance in the bath is necessary in order to obtain a good and even deposit, especially where large and small, light and heavy, flat and hollow articles have to be plated together in one batch. Upon ageing, the solution gradually builds up this resistance from "inert (!) matter" derived from the gradual decomposition of the cyanide; a new solution *needs* such additions, if it is expected to work to satisfaction under adverse conditions as mentioned above. It has been stated in the columns of this magazine, that excellent deposits have been obtained from new solutions made exclusively from metallic cyanides dissolved in alkali cyanide. No doubt about this! What was missing in the statement was a reference to the form and compactness of the objects used in these experiments. Certainly, the alkaline salts brought into the solution gradually augment, but it takes a long space of time, till a rationally maintained solution is overcrowded; by far the largest part of the daily shrinkage in the volume of a plating solution is carried away on the work taken out, and with all the salts it contains; very little is due to evaporation of water only, leaving behind the salts, for the atmosphere of a plating room is sufficiently supplied with vapor from the boiling water, potash, etc., and rather inclined to shed some of its abundance down over a cool plating tank. It would be erroneous to assume that only the metallic additions make up for a material loss in the solution, while the other additions merely supplant their predecessors, which have lost their usefulness by decomposition, but remain in the solution in a changed and inert form.

ALCOHOL PRODUCTION.

The Philippine Islands produce approximately 10,000,000 gallons of alcohol yearly. Almost all of this is made from the sap of the nipa palm that grows in great abundance in various swamps of the country.

GLUE FOR EMERY WORK

AN ARTICLE DESCRIBING THE MANUFACTURE OF THIS IMPORTANT BINDING COMPOUND AND DIRECTIONS FOR ITS USE.

BY WALTER C. GOLD.*

It is very essential in the grinding and polishing of metals that the emery glue be of first quality. Sometimes we have had complaints from purchasers of emery to the effect that it was of inferior quality, whereas upon investigation it was found that it was glue which was at fault. Therefore it is just as necessary to use a good glue as first class emery. There are three fundamental features in the manufacture of glue, which I am confident will be interesting to the user of glues. They are as follows:

First—The materials from which glue is manufactured are technically known as glue stock.

Second—The treatment of the materials, or glue stock, before they are boiled.

Third—The separation or blending of the various "runs."

The principal ingredients used in the manufacture of glue are the bones of animals, and trimmings, cuttings and fleshings from hides and skins. Sinews, feet, tails, snouts, ears and horn-pith are also extensively used as glue stock. The several parts of cattle, calves, goats, sheep, pigs, horses and rabbits yield glues of characteristic and peculiar properties. These are called animal glues. Fish glues are obtained from the bones and skins of fish, but it is the animal glues about which I am particularly writing.

The treatment of the glue stock depends largely upon the factory in which it is handled and the use for which the glue, when finished, is intended. For instance, some factories boil the bones without washing them; on the other hand, some manufacturers steam out the grease by means of volatile solvents. The best bone glues are treated with dilute acid—this removes the lime salts and the gelatinous matter remains. When crushed, these treated bones are called "osseine." The pieces of hides, the sinews, the osseine and the horn pith are treated with lime until properly "plump." The final treatment before boiling varies in different glue works.

The glue stock is not exhausted in one "run"; sometimes as many as ten or fifteen "runs" are needed to entirely extract the stock. It is easily understood that the "first run" glue is the strongest. High grade glues are of high viscosity. This is an invariable rule in glue making. Another thing, hide stock glues are classed as "sweet glues." The condition of the glue stock, the temperature and time of boiling and the type of apparatus employed are all prime factors in controlling the proportion of glue obtained from each "run." The "runs" may be finished alone or blended with some other stock, thus affording a great variety of finished stock. This blending results in a large number of different colored glues, but "appearances are deceitful" and this aphorism applies especially to glue. Even after finished, the manufacturer is obliged to test it in order to assure himself of the true quality of his product.

PHYSICAL PROPERTIES AND CHARACTERISTICS.

Glues for emery work are of various colors—varying from dark brown to light brown and are produced in these forms: sheet, flake, noodle and ground. These glues may be translucent, cloudy or opaque. But the form, color and degree of translucency do not, necessarily, decide the quality of the glue, although the hide stock glues are usually clear and bend almost double without breaking and then break with a clean, quick fracture. Pure hide stock makes the best emery glue; bone stock being brittle and without that necessary tensile strength so essential in gripping the emery grains to the wheel. Emery glue must be flexible or resilient in order to absorb the shock when the work is being brought into contact with the wheel.

TESTING FOR TENSILE STRENGTH, VISCOSITY, ETC.

About four ounces of glue are needed in order that the glue maker may decide the tensile strength, viscosity (or running test) and odor. The mechanical instruments used are the viscosity pipette in a thermostat and a jelly-strength tester with cups.

HOW GLUE SHOULD BE USED.

The proper preparation and application of the glue is as essential as the quality of the glue and the emery. The glue should be soaked over night in cold water, the time for soaking depending upon the type of glue used; ground glue, of course, needing much less than any other form (about 20 minutes). After the soaking it may be dissolved in the steam heater, or glue pot, until it becomes a smooth, flowing fluid. Prolonged cooking, however, injures the tensile strength of the glue. Better prepare only enough for immediate requirements. Pots and brushes should be kept clean, and but one brush should be used for each number of emery. The glue brushes should be kept in clean water while not in use. Good glue, if properly prepared, has no odor. It is surprising how little glue is properly used. Any manufacturer of glues will coincide with this statement. If hot water is applied to dry glue it becomes scalded and, therefore, absolutely worthless. The proper method of preparing glues is by the weight of glue and water. A definite weight of the former should be used with a definite weight of the latter. It is a serious mistake to guess at it!

FOREIGN AND DOMESTIC GLUES.

The impression prevails among glue consumers to quite a considerable extent that the foreign article is superior to the domestic glues. Many emery users insist upon having the foreign glue and, consequently, pay fancy prices. It must be branded, each and every cake. Give the workmen the same glue without the brand and the chances are they would condemn it. In the opinion of the writer (and I speak from long experience) the domestic emery glues are just as good as the foreigners produce, and the prices are less. We have some large glue factories in this country entirely capable of turning out any emery glue equal to or better than any which may be imported.

SUMMARY.

Glue is what may be termed an "uncertain quantity." It takes years of experience to become an expert. With glues, as before stated, "appearances are deceitful" and the only worthy method of determining the quality is through an exhaustive test. When one has a perfectly satisfactory article, one should not be "honeyswaggled" into buying glue simply from its appearance and price. Here the axiom seems to be especially forceful, "True economy lies in what one gets and not in what one pays."

*Of the firm of Walter C. Gold, Philadelphia, Pa.

EXPANDING AND INCREASING THE DENSITY OF GUN-METAL BUSHES

AN INGENIOUS SCHEME FOR CORRECTING A DRAFTING ROOM ERROR.

BY F. R. PARSONS.

A year or two ago the present writer had to machine quite a number of gun-metal bushes, approximately 2½ inches in length, 2 inches external diameter, 1½ inch bore. Actually these dimensions were specified in thousandths, and particular instructions were issued from the drawing office that no deviation whatever was permissible; consequently both internal and external gauges were made in order to obviate any possible error. They were made and delivered, but a few days afterwards came the disquieting news that they were not to the sizes specified, and as a result would be rejected.

Very naturally the blame was assigned to the shops, but the writer upon verifying his gauges with the information supplied him quickly dispelled this idea. Ultimately the error was discoverd to have originated in the drawing office, both internal and external dimensions being incorrect. The specification required them to be 2.038 inches externally, and 1.513 inches in the bore. The last figure of the first dimension being read as a 3 made the bushes .005 inch small, while

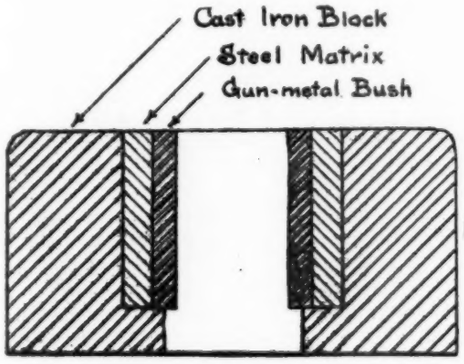


FIG. 1. CAST IRON BLOCK FOR EXPANDING A GUN METAL BUSH.

a careless survey of the figures in the latter dimension was responsible for an error of .008.

As the total number of bushes ran into several hundreds, the idea of scrapping them was one generally disliked, and not to be accepted until every known remedial measure had been discussed. The error in the bore could of course be rectified by careful chucking and re-boring, but as it was known that the outer diameter was a pressing fit, this idea had to be abandoned.

However, it fell to the lot of the writer to find a way out, and after a little thought he determined to see what could be done by expanding them. Taking into consideration the fact that externally they would require expanding .005 inch, and internally .008 inch, the difference, viz. .003 inch, would best be dealt with if the metal could be compressed this amount. With this end in view, he had a cast-iron block made as in Fig. 1, 6 inches in diameter and 4 inches thick, bored it out centrally to a diameter of 2¾ by 2½ inches in depth. This was counterbored the remaining depth of the block to 1¾ inch diameter. Into the larger diameter of the hole was forced a steel matrix, its internal diameter being exactly the size required of the gun metal bushes, namely, 2.038 inches.

Internally the steel bush was very smoothly finished in order to free it from tool marks or scratches of any description. A tool steel expander was next made, 7 inches in total length, the first 1¼ inches of its length being tapered from 1.504 to 1.513 inches, the latter being the size required for the bore of the bush. The next 3 inches of its length was parallel, the remaining 2¾ inches being .005 smaller. This expander was first rough turned to within .008 inch of size, then hardened and finally circular ground to the finished dimensions; a perfectly smooth and deep polish being imparted to it. This is shown in Fig. 2.

The bushes were each placed into the matrix, the expander inserted, and the whole placed under a small hydraulic press, and the expander forced slowly through the bush, no lubrication whatever being applied. The result exceeded anticipations. There was little trouble experienced in removing the gun-metal bushes from the steel matrix after expansion; externally they were correct in size, and the bore presented a beautifully burnished appearance, the skin being absolutely free from marks of any kind. And what is more, the density of the metal was considerably increased. Needless to add, upon their being again sent out they were accepted.

As no opportunity was then afforded the writer of putting one of the bushes to a running test in order to determine what value the act of increasing the metal's density had in relation to its wearing qualities, he had a gun-metal bush made, and its internal bore

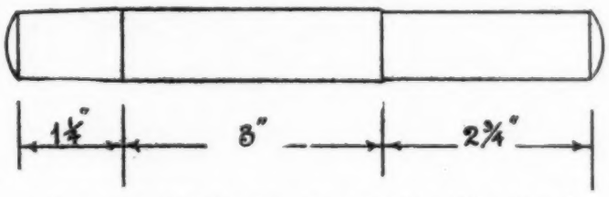


FIG. 2. THE EXPANDER USED IN BLOCK SHOWN IN FIG. 1.

expanded, as in the example, and set in a bearing of a high-speed machine running day in and day out at a speed of 2,000 revolutions per minute. This was quite eighteen months ago, and a recent inspection showed that the actual wear was under .003 inch, as compared with one on the other side of the machine, not so heated, showing a wear of .025 inch; thus conclusively proving that gun-metal so compressed possesses enhanced wearing qualities.

COAL FOR COKE.

In the last five years the coal used in metallurgical coke manufacture has averaged around 65,577,000 tons, yielding 43,983,000 tons of coke, valued at $111,736,000. Of this total, 14,767,000 tons were used in by-product coke ovens, yielding beside the coke, 54,491,000 thousand cubic feet of gas, 94,306,000 gallons of tar, and $9,109,000 worth of ammonia. When it is taken into consideration that every year approximately four times these enormous totals of by-products are absolutely wasted through the use of non-by-product ovens, the vital importance to the country of a general use of the modern, scientific by-product ovens will be appreciated.

THE STRIPPING OF METAL DEPOSITS*

AN EXPLANATION OF ONE OF THE TROUBLES OFTEN EXPERIENCED BY THE ELECTROPLATER.

BY GIRALDUS JONES.†

My subject, which must be of no small concern to the practical plater, is one which, in my opinion, has been given but scant attention in most text books. This may be due to the fact that the majority of authors—not being actively concerned in large outputs and the serious inconvenience caused in such cases by strip work—have not deemed it necessary to give the subject anything more than a mere passing reference.

Stripping is generally attributed to imperfect cleaning. We admit that that is largely responsible for troubles of this nature, but beyond a very cursory definition of "cleanliness," text books do not probe into the causes which render all efforts to obtain this chemical cleanliness so futile in some cases.

True, we are told, in the case of nickel solutions, that these must not be too acid—on the contrary, they must not be too alkaline.

When cyanide solutions are under consideration, the injunctions are usually to the effect: Do not employ an excess of free cyanide and, on the other hand, let there not be a deficiency.

"Do not use too high and avoid using too low a current density" is an instance of one of the vague generalities usually included in works on electro deposition.

Perhaps the extremely limited range of most authors' experience in shop practice and commercial methods may account for their brevity when dealing with this phase of the subject.

Every electroplater of varied experience is aware that what may be expedient in depositing on one class of metals may be quite detrimental in the case of another class possessing quite different electro-chemical values.

Again, it is frequently found that conditions eminently suitable for the production of light deposits are totally valueless when deposits of a heavier character are required, even though the metals deposited on are similar.

It is absurd, therefore, to adhere rigidly to such counsel, because the composition, variety of shape, and the depth of deposit are inter-related, and any one neglecting to consider the problem from these standpoints will certainly find trouble.

Instructions, as well as the principles on which they are founded, must in all operations be regarded by the practical man as being flexible to an almost unlimited degree, otherwise experience will soon teach him that circumstances alter cases, and that stripped work may be brought about from a variety of cases. A few of the most prominent and important conditions which contribute to that most undesirable effect will now be discussed.

STRIPPING CAUSED BY HYDRO-CARBONS.

Every plater is aware of the value and function of the potash tank, but there appears to be many whose knowledge is somewhat limited in regard to the range of its action on greases and oils generally.

I frequently come in contact with men who hold the view that the potash will cleanse anything of greasy nature, notwithstanding the composition of that grease or oil.

This is a serious fallacy, and it is remarkable that platers who have been in the habit of working to instructions with their plating solutions do not appear ever to have had any information regarding the limitations of potash on the removal or saponification of grease or oil.

Owing to the extensive adoption of bright soft steel stampings in the cycle and other trades, platers are frequently confronted with difficulties in the removal of greasy substances with which these goods are coated to preserve them from rusting. Sometimes the grease is entirely removed by the polishing operations, but when such is not the case, the difficulties of removal are borne by the plater with more or less success dependent upon his acquaintance with its nature.

A recent incident, which probably can be confirmed by similar experiences of a number present, will illustrate this. The difficulty presented itself in connection with the plating of rims, which had been coated with a grease somewhat resembling vaseline in general appearance. Not only were these rims coated on the front or polished portion, but on the backs also, which parts were left untouched in the polishing processes.

On immersion in the hot potash tank, the high temperature caused this semi-solid substance to soften and spread, until it ultimately worked through the spoke-holes on to the front of the rim. It only needed scouring in the usual manner to become spread as an imperceptible film, all over the rim, and, from the nature of the beading and sectioning, the metal was more porous on the convex areas, and naturaly harbored the grease, which, on its subjection to the cold water swill, again assumed its former semi-solid consistency right down in the pores of the metal. It was found, irrespective of the length of time in the potash, and regardless of the efforts of the scourers, utterly impossible to nickel-plate successfully, stripping being the final reward.

That was because the grease was a product of the hydro-carbon group. It may be interesting to explain the nature of oils and greases which do effect saponification by the action of caustic alkali.

These belong to what are termed the natural fats—both vegetable and animal—and their composition generally consists of glycerol or glycerine and an insoluble acid, of which stearic acid (C_{18} H_{34} O_2), palmitic acid (C_{16} H_{32} O_2), and oleic acid (C_{18} H_{24} O_2) are examples.

Glycerol is also known as propenyl alcohol. Its formula is C_3 H_5 $(OH)_3$ and is soluble in water.

Stearin is known as being largely employed in the manufacture of polishing compo. Its more scientific title is glyceryl tristearate. Its formula is C_3 H_5 $(C_{18}$ H_{35} $O_2)_3$ and in its pure condition is obtained usually by melting beef or mutton suet, separating the fibrous matter by filtration and crystallizing in small flasks from solution in hot ether.

Natural fatty bodies undergo the change termed saponification when boiled with alkali. The fat is decomposed into its principal constituents, namely, a fatty acid which combines with the alkali, forming a soap, and glycerol (or glycerine) is set free. Both, however, pass into solution. The action may be expressed thus: C_3 H_5 $(C_{18}$ H_{35} $O_2)_3 + 3$ KOH $= C_3$ H_5 $(OH)_3 + 3K.C_{18}$ H_{35} O_2.

Now from this equation, it can be seen that as the work proceeds the potash solutions become concentrated, or loaded with glycerine and potassium stearate, and in the whole course of my experience I have never yet met a plater who made any attempt to recover or remove the soap from the potash solutions, for use either in the works or at home, and yet we find in our very large hotels, where economy reigns, it is a very regular practice to make soap from all the greases obtained in the kitchen.

It is for this reason I advocate complete renewals of

*A paper read at a recent meeting of the Institute of Electro-Platers, Birmingham, England.

†Representative of Langbein-Pfanhauser Works, Ltd., Germany.

potash solutions after a certain time rather than keep adding fresh alkali to old solutions. The cost need be no more.

Any plater may recover the soap from his alkali solutions, by simply adding common salt, which will cause the soap to separate out. If the alkali used is caustic soda a hard soap separates, and in case of caustic potash soft soap is obtained.

The effect of the salt is to render the soap tolerably free from caustic alkali, which may be severe on some skins. Further purification is effected by re-boiling the soap. The petroleum jelly used as a preservative on steel is made by dissolving one part of paraffin wax in five parts of heavy mineral lubricating oil. Potash does not decompose this substance, with the result that stripping often follows.

Stripping Caused by Excessive Current Densities.

Now we arrive at an entirely different cause of stripping; and while advocating the practice of rapid deposition at the highest permissible rates, it will be obvious that prudence must prevail if the results are to be dependable, and not of such a character as to demand too much attention during deposition on the part of the operator—a consequence which might lead to the condemnation of the practice as having no commercial value.

In arriving at a suitable current density to be employed on a given work, no conclusion will be satisfactory unless due consideration is paid to the nature of the metal; its superficial area must be considered in conjunction with its section and general contour; for superficial area considered alone is utterly unreliable as a guide and should be applied only to sheet metals, and articles having plane surfaces.

Articles having projecting points, occupying positions well in advance of the body, and in close proximity to the anodes, need very careful manipulation owing to the tendency of the current—as with all other forces—to travel along the path of least resistance.

The resultant effect is an abnormally high current density on these projections, although the current density, if calculated over the total area of the article, would appear to be quite normal.

Were it not for the projections lying adjacent to the anodes, no stripping would occur. To verify this one has only to double the anode distance using the same current density, and a sound deposit is at once obtained.

The reason is primarily an electrical one, because when too near the anodes, protruding parts tend to act as receiving points for the current.

Another instance of partial high density comes about automatically, and indirectly sends up the rate of deposition on parts of the cathode, and this condition arises from negligence in allowing hydrogen gas *bubbles to adhere to the articles*. Apart from other objectionable effects of gas accumulations, the feature now to be considered is the non-conducting property of these gas bubbles, and the influence they exert on the deposits.

Let us suppose a condition of things where deposition is proceeding just within the safety limits, and that the usual precautions of raising the rod out of the vat, or otherwise preventing the collection of bubbles, is not carried out.

The consequent accumulation of gas bubbles until half the superficial area of the cathode is covered, would mean the complete insulation of the latter from the electric circuit. There would occur no corresponding reduction in the total volume or quantity of current flowing through the article. The reduction in these circumstances, if any, would be negligible, and although half the area becomes cut out as it were, the whole of the current would flow by the paths not affected by the gas, with the result that the current density is virtually doubled on the exposed areas. This, apart from the evil effects of pitting, is the sole cause in many cases of stripped work. The back E. M. F. due to this polarisation is too negligible in works practice to have an appreciable result in rapid plating.

The E. M. F. of any form of cell depends upon the difference between the heat values of its elements, and as the result of the gas bubbles is to form a cell, the amount, or rather intensity, of which is governed by the difference between the heat values of hydrogen and the element forming the anode. It sometimes reaches about one-third of a volt—with which amount practical men using dynamic electricity need not concern themselves.

Some respected authors, however, believe in coppering positive metals to counteract the tendency to create B.E.M.F., but such advice is valueless and misleading, inasmuch as polarization or gas bubbles only concern the plater after deposition has proceeded some time, and the article is already coated with its deposit; so that this counter E.M.F. generates from the hydrogen gas, and has nothing whatever to do with the deposit or the basis metal to which it adheres.

It may be advisable for a different reason, which I will explain, to recommend coppering on highly positive metals, because, on immersion in acid solutions of metals of a more negative character, an exchange takes place and this action will produce defective plating.

Stripping Due to Physical Causes.

One of the most perplexing forms of strip work is the variety that develops some considerable time after the goods have actually been in the hands of the users. No fault has been detected during the process of manufacture notwithstanding careful examination for defects by experienced viewers.

Some authorities ascribe the cause to the action of atmospheric influences, particularly that of moisture, which in varying proportions is always present in the air. It is argued—and sometimes with accuracy—that the deposit, being of a porous structure, permits humid air to penetrate through to the underlying metal, and in case of iron being the basis metal, to set up rust, by which means the deposit would loosen and strip. Oxidation also takes place, according to their views, on such base metals as copper, brass, zinc, and tin.

While there is no doubt of the accuracy of this view in particular circumstances, it cannot be applied to all cases generally, otherwise no satisfactory result would be likely to be attained in nickelling on cycle work.

Now a deposit of nickel 1 to 1½/000 in diameter is full proof against atmospheric attack, and an article plated with such deposit will resist any corroding agencies of the nature mentioned. Therefore it cannot be correct to say the deposit is porous, which opinion has become rather prevalent, and in some degree welcome, among manufacturers of very badly plated wares who would cover up their own deficiencies.

To prove whether the deposit is porous or not is very simple, and can be very quickly ascertained by dipping the article into a solution of copper sulphate, or by rubbing a piece of wet copper sulphate crystal on the plated surface.

Should the deposit be substantial no effect will be observed, but if porous and thin a reddish tinge will be noticed on the parts where the rubbing is applied; this is due to the moist solution of copper sulphate percolating through the deposit and effecting an exchange with the iron by the simple immersion process. The rubbing in my view is a better test than the dipping method. Therefore, it is wrong to attribute certain kinds of stripped work to the porosity of the deposit under at-

mospheric influence which is the cause usually given.

I am inclined towards finding an explanation by considering the physical properties of the metals under the natural laws of expansion and contraction, due to variation in temperatures to which the articles are sometimes unavoidably subjected.

Every metal or alloy has its own invariable co-efficient of expansion, that is, for every degree the temperature raises, the metal expands, and in exactly the same ratio shrinks as the temperature falls.

Should the deposited and basis metals expand or contract at substantially different rates it will be agreed that there must be opposing forces at work, and the deposit, being naturally the weaker metal, breaks up.

In order to impress my meaning of the importance of these properties of metals, let me describe the case of the incandescent electric lamp. The current enters the glass bulb by means of platinum wires, no other metal exactly answering the requirements is known, and this expensive metal is employed not because of its high melting point, which is a great advantage, but because its co-efficient of expansion is identical with that of glass. No matter how the glass expands and contracts during switching of the light on and off the platinum wire expands and contracts at exactly the same rate.

If this were not the case the glass would either burst (with the wire expanding at a faster rate) or it would allow the air to work gradually through the bore of the glass (if the wire expanded at a slower rate), and the presence of air in the bulb would consume the filament instantly.

(To be continued.)

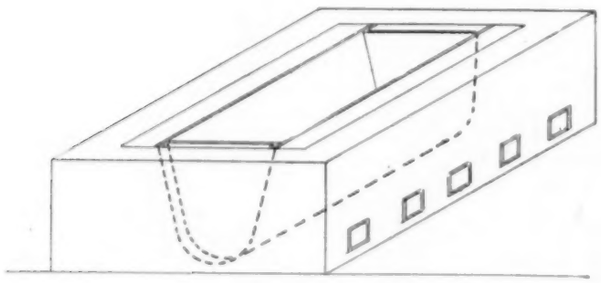
GALVANIZING

SUGGESTIONS ON EQUIPMENT FOR THE "HOT DIPPING" PROCESS.

BY J. HOWARD VAIL.*

So much has been written by able writers on the theory of galvanizing it seems it is possible the practical side has been neglected, or overlooked, as from reading the theoretical explanation of how to do galvanizing, and doing the actual work, is quite a long step. I do not believe, from my own experience and observation, that I know of any theoretical galvanizer that would be able to do practical galvanizing, that is to say, from a commercial and profitable standpoint. Nevertheless, theory should co-operate with practice.

The "hot dipping" process of galvanizing is really the only one that I could or would advocate for certain kinds of work. Electro-galvanizing, and sherardizing have their uses, for threaded work, such as



SHOWING METHOD OF SETTING A GALVANIZING KETTLE.

small bolts, nuts, screws, etc., which by the hot process would require to be recut, and by the other processes they would not require it, thereby eliminating that expense. In the "hot dipping" process the first requirements are a kettle of proper dimensions for the work intended. Made of best tank steel or "fire box" steel plate, either riveted or welded ends. Body of kettle understood to be of one plate, bent to shape, as I would suggest of "U" shape instead of "V" shaped, as many are or have been made.

My reasons for preferring the vertical sides are that the "V" shaped kettle lies at an angle at top to get too much heat, the inside accumulates the oxidized skimmings, consequently corroding from inside, and too much heat from outside will burn the plate out much sooner. Have the kettle properly bricked up by fire brick and preferably without grate bars, but with plenty of draft holes, which will be found easier to control the temperature.

Pyrometers are in general use in recent years, more particularly so when one class of work is continuous. Coke is the fuel most generally used—good quality of gas house coke. Of oil burning kettles I only know from hearsay, never having had any experience with one. Tools such as tongs, hooks, pokers, etc., for handling galvanized work in the process can easily be made by any first class blacksmith to fit any desired object to be galvanized, suitable to the workman or the job in hand. Wooden tanks for sulphuric, hydrofluoric and muriatic acids are required; also a large water tank. Also drying oven situated at convenient place to obviate over handling work, preferably at one end of the kettle, to one side, to allow room at end for handling long bars, etc. Any one of the well-known brands of western spelter produces good results, if properly handled.

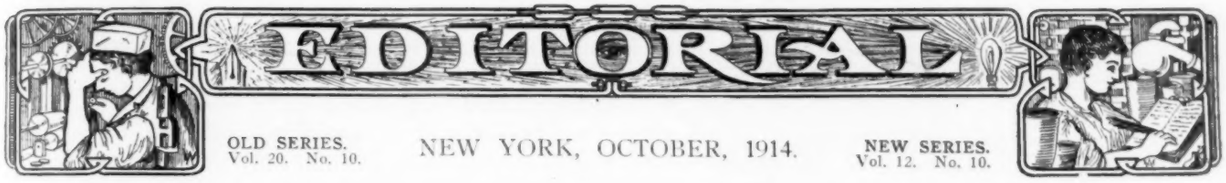
There are several grades of sal-ammoniac. The gray kind is usually used for fluxing, and the white granulated for dusting. The white, floury sal-ammoniac, such as manufactured for electrical purposes, is more apt to lump up, and is not as quick acting as the better grade of white granulated, which costs but a trifle if any more than the first named, and will be found more economical. An ample supply of water is necessary, as there is almost a continuous use of water, for which proper drainage should be arranged. Steam is also part of the equipment not to be overlooked, and in almost any large manufacturing place is a small matter to pipe same to acid tanks.

Also proper ventilation is requisite, as the fumes from acid and sal-ammoniac are in constant evidence, which if continued cause no end of discomfort, not to say injury, to the workmen. Last, but not least, get a good, experienced man to superintend the building and equipment of the plant, and start right. It is economy, both in time and money, and time is money in this hustling age.

*Formerly proprietor Boston Galvanizing Works, Boston, Mass.

CHEAPER PLATINUM.

Hitherto Russia has been practically the only source of supply of platinum. Under these circumstances a large group of industries will welcome the discovery of extensive deposits at Wendem, Westphalia. Over 100 analyses of borings have been made and all showed the presence of metal in amounts sufficient for profitable extraction.



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BUSINESS IN WAR TIME

Although the letters published in this issue of THE METAL INDUSTRY from various sections of the United States do not reflect a very busy state of affairs in the business world, there is, at the same time an optimistic color reflected in all of them. It is perhaps too early for decided changes to make themselves manifest for the disastrous and unnecessary war of the nations abroad came just at the "peak" of a general business depression. There are, however, some very good grounds upon which to base a prophecy for a change for the better in all sorts and conditions of industrial pursuits. One basis for warranting such an opinion is to be found in an interview with A. Wilzin, managing director of E. W. Bliss Company, of Paris, large manufacturers of machinery used in the metal trades. Mr. Wilzin is quoted in the American Machinist of September 24, as follows:

"Practically all the machine shops of continental Europe are now closed, for the simple reason that there is no money to be had to pay the workmen or buy material, and because most of the foundries have been unable to keep a sufficient staff to manufacture castings; also for the reason that even if the goods could be manufactured, and the workmen could be paid, there are no shipping facilities to get rid of the product. This is the general situation. There are, however, a few exceptions, such as firms manufacturing war material for the government and thus receiving cash payments and advances from the state. These in virtue of their military connections can hope to receive special favors in the way of transportation facilities.

"Fortunately, our works here have been doing some government work in the way of cartridge machinery, can-making machinery for militarized can-making shops, and so on, so that the payments thus received have enabled us to continue on a limited scale. My principal object in keeping the works going is to be able to pick up business quickly and economically when it comes.

"The men we have kept are the older ones, and foreigners belonging to neutral and friendly powers, such as Italy, Spain, Holland and England. All of the younger men have gone to the front and many of them, unfortunately, will not return. There will be some considerable trouble and time required to reorganize the fresh labor necessary to replace the trained men who do not return from the battlefield.

"However, on the other hand, we expect a greater bulk of trade ultimately, at least in this country, because Germany used to export large quantities of goods, which will, in the future, have to be made in France, or imported from England or America, as no Frenchman will be apt to buy German goods in the future, if he can possibly get them elsewhere."

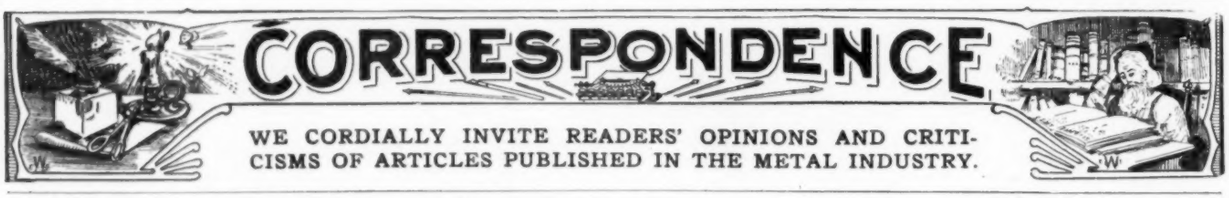
The The New York Times of October 1 has an interview with V. C. Lassen, who has just returned from Russia and is here in the United States for the purpose of purchasing materials for the Russian government. Mr. Lassen was until recently connected with the Victor

Metals Company, of East Braintree, Mass., but went to Russia to operate his own factory. Mr. Lassen says of his wants and of prospects for future business from the United States:

"There may be some war material needed, but I am looking particularly for medical instruments and supplies, medicines, a good deal of castor oil, and a quantity of clippers for cutting barbed wire, which plays such a prominent part in defense nowadays. It is hoped that shipments can be made via England and Archangel, but it is unlikely that Archangel will be open to navigation more than five weeks longer, owing to ice. I had hoped that the Dardanelles would be kept open. Now that the entrance to the Black Sea is closed, we may have to ship by way of Japan, Vladivostok and the Trans-Siberian Railway.

"It is important to note that from now on the opportunities for American manufacturers in Russia are going to be tremendous. That is a market in which Germany, in one way or another, has enjoyed almost a monopoly. Why, the Germans have even been buying American machinery over here, which its manufacturers, perhaps, never dreamed was destined for Russia, and selling it in that country at twice the prices it sells for here. Of course, Russia is buying no German goods now, and after the war will not buy them. The war feeling is intense."

Here, then, are two sources to which American machinery and metal manufactures may be diverted. The logical thing to do then is to study carefully the list of products made in Germany and exported to both France and Russia and in fact to other countries and set the mills and shops working on these things, for manifestly the market is rapidly being made ready and shipping facilities will undoubtedly be forthcoming. On the other hand, a great deal of attention should be given to products which up to the time of the war were imported into the United States. Here, too, is a prolific field of enterprise, one that offers unlimited opportunities for expansion of home industries. This field is of such a varied character that it is impossible to enumerate in a brief space more than one or two examples. First and foremost among important importations comes articles manufactured abroad in the shape of novelties and cheap jewelry made of metals. We have the metals, the shops, factories, foundries, and, best of all, we have the help necessary to turn out these things. Another important industry that we might turn our attention to for home consumption is that of lacquers and enamels. These products are in great demand and their use goes hand in hand with metal manufactures.



ELECTRIC CURRENT REGULATION

To the Editor of The Metal Industry:

In answering Mr. George A. Pope's criticism*, on my new device for regulating the strength of the current in a plating bath independently of the voltage, I regret to say that your correspondent does not seem to understand in a clear and concise way the workings of my controller. Mr. Pope says: "With a small load your contributor finds it necessary to use a switch for cutting "on or out an additional wire resistance." Later he also speaks of removing anodes. His meaning is not clear, but I

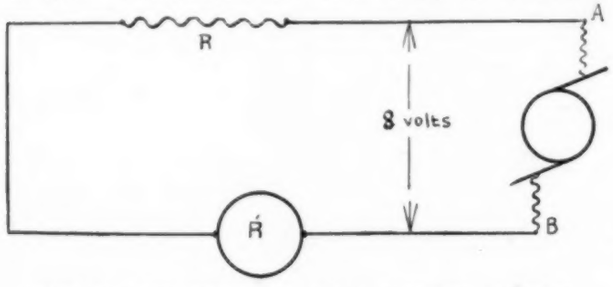


DIAGRAM EXPLAINING THE ROJAS ELECTRIC CURRENT CONTROLLER.

imagine he thinks that I have a wire rheostat embodied in my apparatus. Such is not the case; I do not remove the anodes; neither is there any additional wire rheostat; the apparatus simply comprises two anodes, one large and one small. By the manipulation of suitable switches these anodes can be used either separately or conjunctively to afford an easy adjustment of the current to large or extremely small loads; such effect being further assisted by the controlling parts of the device.

I will again state what the purpose of my device is: I claim that with this new controlling apparatus, the plater is able to increase or decrease the strength of the electric current within the derived or parallel circuit of a plating bath independently of the voltage or difference of potential between the positive and negative electrodes. My object in doing this is to keep the voltage as high as possible between the anode and cathode, gaining thereby, the advantages that I have already pointed out in my previous article.

To make my meaning clear, I will resort to some graphical and mathematical proof. Referring to the accompanying figure, let us assume a difference of potential of 8 volts between the wires A and B, and outside resistance R of 3 ohms, and a plating bath resistance R' of 1 ohm, the current in the line according to Ohm's law will be:

$$C = \frac{v}{r} \text{ or } C = \frac{8}{31} = 2 \text{ amperes}$$

From this we will find that the fall of potential at the resistance R is

$$v = cr \text{ or } V = 2 \times 3 = 6 \text{ volts}$$

and the fall of potential between the electrodes at the bath will be

$$V' = 2 \times 1 = 2 \text{ volts}$$

Let us suppose now that it is desired to reduce the current in the bath to 1 ampere; to do it by the old method we will increase the outside resistance to the value of

$$r = \frac{v}{c} \text{ or } R + 1 = \frac{8}{1} \text{ or } R = 7 \text{ ohms}$$

Let us see what changes this increase of resistance has made in the line; it will be found that the drop of potential across resistance R is now

$$v = rc \text{ or } V = 7 \times 1 = 7 \text{ volts}$$

instead of 6 as before, and that the fall of potential between the electrodes at the bath is

$$V' = 1 \times 1 = 1 \text{ volt}$$

instead of 2 as previously; this shows that whenever we increase the resistance between two points in an electric circuit we increase the difference of potential between these two points and decrease the difference of potential through any lower resistances of the circuit. Let us now accomplish the same reduction of the current by the new way, that is, by increasing the resistance

*The Metal Industry, September, 1914.

in the electrolyte between the anode and the cathode; as done by the new controller. For the same current of 1 ampere the added resistance in the bath, removing all the outside resistance R of the rheostat, will be

$$r = \frac{v}{c} \text{ or } x + 1 = \frac{8}{1} \text{ or } x = 7 \text{ ohms.}$$

The drop of potential between the electrodes at the bath will be now

$$v = rc \text{ or } V' = (7 + 1)\ 1 = 8 \text{ volts.}$$

instead of 1 as was the case when the outside rheostat was used. We have now the same reduction of 1 ampere delivered at 8 volts pressure between the electrodes, which proves my statement that with the use of my device the plater can increase or decrease the current in the bath independently of the difference of potential between the anode and the cathode.

Mr. Pope says, "I should be glad to see Mr. Rojas prove on paper the basis which he claims that none of the current is wasted by using the new system, as compared with the usual method, because, after all, one only pays for the actual watts taken from the dynamo."

I fail to see the logic of this argument. We all know that we only pay for the power consumed, but this power, or part of it, may be wasted or put to useful work, I claim that the proportion of the power that is consumed in the resistance wires of an outside rheostat is transformed into heat and wasted in the atmosphere. In the case above cited, this amount or waste would be equal to

$$W = \frac{v^2}{R} = \frac{7^2}{7} = 7 \text{ watts.}$$

If by using the new controller this wasted energy is transfered into the plating bath, it will be put to the following uses:

1st—To increase the temperature of the bath and with it its specific conductability, saving thereby, the energy that would have been wasted in overcoming a higher co-efficient of ionic friction.

2nd—It will act efficiently against local and counter currents, rendering thereby a more uniform and coherent plate in a shorter time than at present and saving the energy that would have wasted in carrying the plating operation for a longer period of time; and

3rd—It will help to keep the anodes from oxidization with less amount of free reagents, rendering the chemical reaction of the bath upon the deposit less destructive and consequently the desired deposit will be obtained in a shorter time, saving also time and energy.

Aside from these advantages other facilities are also gained; as is the perfect control with which the accurate adjustment of the strength of the current to the cathode surface can be accomplished; inasmuch as the jumps that the variations of the current makes, when this is regulated by an ordinary outside rheostat, are perfectly eliminated. By the use of my device this adjustment can be obtained smoothly and at any desired value. Also the great range of adjustment needed to handle big and small loads do not present the mechanical difficulties that are encountered in the construction of the ordinary rheostat, and, therefore, this new controller can be produced at a more reasonable price.

Mr. Pope says, "The difficulty of manufacturing it in suitable materials for different solutions, in my opinion, puts it out of the range of practical plating." I consider this a very broad statement; I have found this to be the least of our difficulties.

New York, September 21, 1914. F. A. Rojas.

GOLDFILLED STOCK

To the Editor of The Metal Industry:

In the March issue of an optical journel an attempt was made to illustrate how seamless alloyed gold filled wire was made for the optical trade. This article, and the cuts shown in that journal, must have furnished a great deal of amusement for the manufacturers of optical goods. For instance, one part of the article was as follows:

"Imagine a man carrying on his arm a tin pan, shaped exactly like those your mother used to use for making cake, containing $1,400 in gold eagles. Imagine those gold eagles placed in a melting furnace with the necessary alloy to make the karat desired."

That was one of the starting points, and that is one of the points that the manufacturers of optical goods would consider a joke, as in these days up-to-date manufacturers of seamless filled wire for the optical trade do not use coin gold. Coin gold is a little better than 22 karat. We know of a ten-dollar gold piece which was put through a bank and was returned with the word "light" stamped upon it. After weighing it and figuring it out, we found that it was 7 cents shy. That was because it had been carried and worn, so that it did not weigh up to the standard. That is the reason why coins are not used for manufacturing wire. The United States Government will now sell gold bricks that will assay 999.4 to up-to-date seamless wire people. They always buy the Government gold brick. They will never buy coins, as they always want to know just what fineness the gold is that they use. The party who wrote this article was perhaps an amateur at the seamless wire business. He had very little experience and must have been a beginner, and a person who begins to make seamless wire always makes a great many mistakes.

There are a large number of seamless wire manufacturers now that have been in the business for some time, and they have had a large amount of experience. Their aim is always to make their quality of wire up to the standard, and there is no optical manufacturer who buys wire from any first-class manufacturer of seamless gold filled wire that is not able to stamp his material and stand back of it. In the first place, if he buys 1-10 12 karat wire from the experienced maker, he knows that it is 1-10 12 karat, and he has a perfect right to stamp it 1-10 12 karat. The manufacturer of the wire stands ready to back it up, and he can buy the wire cheaper from the manufacturer of seamless wire than he can make it in his own factory. He also knows that the makers of seamless filled wire for the trade have a great deal more experience than he would have if he were making it for himself, as they are not only making it for the optical manufacturers, but also for the manufacturing jewelers.

"Karat."

NEW BOOKS

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY.—Volume 25. 1914. Size 9¼ x 6¼ inches. 544 pages and numerous illustrations. Bound in cloth. Edited by the secretary and published by the society.

This volume is the report of the twenty-fifth general meeting of the society held in New York City April 16-18, 1914. Included in the work is a list of the officers of the society, together with the names of those present at the meeting.

The main part, of course, is made up of the addresses and papers which were read and discussed at the various sessions of the meeting. Taking it all in all the volume is a worthy addition to the large amount of matter which has already been published by this energetic society in form of these transactions.

STEEL WORKING AND TOOL DRESSING.—By Warren S. Casterlin. Size 8 x 5¼ inches. 207 pages, including index. Illustrated. Bound in cloth. Published by the M. T. Richardson Company. Price $2.00. For sale by THE METAL INDUSTRY.

This is a manual of practical information for blacksmiths and other workers in steel and iron. It was written by an expert, the author having had fifty-seven years' experience at the forge, and is probably the first book of the kind by a really practical blacksmith and steel and iron worker. There is not a superfluous word in it, and although it is impossible to cover a subject of this kind exhaustively in a book of two hundred pages, yet by leaving out that which practically everybody knows, there is room for about all that everybody ought to know and yet does not know. The information given is thus largely new and cannot be found elsewhere. The book is well printed and bound, and carefully indexed for quick and easy reference. A copy should be in every blacksmith shop and within easy reach. The work is illustrated where illustrations are necessary.

Shop Problems

IN THIS DEPARTMENT WE ANSWER QUESTIONS RELATING TO SHOP PRACTICE OF THE METAL INDUSTRY. ADDRESS THE METAL INDUSTRY.

ALLOYING

Q.—What alloy (indicating its analysis) would you suggest for a casting with thin walls to resist carbon di-oxide at high pressure? We are having trouble with leaking and cannot increase the thickness of the walls.

A.—The best alloy for the manufacture of thin walled castings to withstand carbon di-oxide at high pressures, is hydraulic metal. This alloy has the following composition:

Copper	80.24
Tin	7.40
Zinc	12.36

Pure metals should be used, as traces of aluminum, antimony, etc., are very detrimental and may cause leaks.—J. L. J. Problem 2,038.

COLORING

Q.—We have an order to make some castings for a customer and he desires same to have a nice golden color, same as found on high grade stop and waste cocks or bodies of high-class steam valves. Also advise if these castings are dipped or pickled to bring up this color.

A.—Use virgin metal in casting these goods. The mixture for virgin metal is composed as follows:

Copper	87
Zinc	4
Lead	2
Tin	7

To bring up a good color allow the castings to stay in the moulds a certain time and then shake out and plunge in cold water and the desired color will be obtained by the length of time you allow the castings to stay in the mould before blowing out. The heavier the castings are the longer they should stay in the mould. By experimenting you will find out from the first heat you run when they should be taken from the mould.—P. W. B. Problem 2,039.

CORROSION

Q.—Can you furnish us with a metal formula that can be used for a container for hot caustic soda?

A.—Cast steel or cast iron containing ½ per cent. of nickel would be the best material for resisting the action of hot caustic soda solutions. Of the non-ferrous metals, monel metal would be the most satisfactory. You might try pure copper, deoxidizing with four ounces of 10 per cent. silicon copper for each 100 pounds of copper. Tin, lead, zinc, antimony, etc., or alloys containing them, are all more or less attacked by caustic soda.—J. L. J. Problem 2,040.

EMBOSSING

Q.—How can I obtain the embossed surface on the enclosed sample of sheet steel?

A.—The finish upon the cold rolled steel submitted as a sample is probably produced in the following manner:

First.—The cleansed steel surface is coated with a black rubber finish baking enamel, such as used on automobile lamps. This may be accomplished by either the dipping or spraying method.

Second.—After the enamel is baked, as is customary with such enameled or japanned steel surfaces, the steel is then passed through embossing rolls, such as are used for embossing sheet brass. Almost any design can be produced upon the enameled surface as with brass.

Third.—If only one side of the coated metals is to be embossed, then only one embossed steel roll is used. The other is left plain. For embossing on both sides, both rolls must be embossed or cut as the term is used. The small rolling machines are a stock article, but rolls must be engraved or cut especially for the designs desired.—C. H. P. Problem 2,041.

FINISHING

Q.—Will you kindly give us a formula for obtaining a good bronze finish on articles having a deposit of electrolytic copper? We should also be pleased to have you recommend a quality of lacquer suitable for use after the required finish.

A.—To produce a bronze finish on a deposit of electrolytic copper there are numerous ways and means.

A very simple method is to dissolve from 12 to 16 ounces of common sulphate of copper in one gallon of boiling water and immerse the articles in this solution until a satisfactory bronze tone is produced.

The other methods in vogue are as follows:

Immerse in a solution of 1 ounce of barium sulphite to a gallon of water. This solution may be used hot or cold. When used hot a more dilute solution may be used. This solution produces a beautiful brownish tone and is probably one of the best mediums for producing a bronze tone.

A solution consisting of a half to one ounce of sulphuret of potassium may also be used in a like quantity of water or a quarter to a half ounce of hydro sulphuret of ammonia may be used in a like quantity of water, hot or cold. By the aid of the sulphuret a deep bronze tone may be obtained, according to the strength of the solution you use.

After the bronze tones have been produced the articles should be washed well in cold water and then in boiling water and dried out thoroughly by the aid of heat or maple sawdust. If a lustre is desired the articles, after drying, should be lightly scratch brushed, using a very fine wire brass brush for the purpose. A brush known as the crimp wire variety gives the best results. The speed of the brush when in use should not exceed 600 to 800 revolutions per minute.

If it is desired to show the surface in relief the bronze in the background should be left dark and the high lights made lighter. This may be accomplished by using pumice stone and water and scouring the high lights, using a piece of felt or common rag for the purpose. If the surface has to show a polished effect then it will be necessary to polish the high lights with a regular buff, using white composition for the purpose.

Lacquer for your purpose can be obtained from the lacquer manufacturers whose advertisements appear in THE METAL INDUSTRY.—C. H. P. Problem 2,042.

GALVANIZING

Q.—I understand that handles on aluminum ware are made of steel and are plated. Will you kindly give me a formula for an aluminum solution?

A.—Handles of iron and steel used on aluminum ware are not, as you suppose, aluminum plated, but are electro-galvanized. When a good deposit is obtained from such a solution it has the appearance of aluminum and in some instances the anodes are made up with an alloy of from 90 to 95 parts of zinc and 5 to 10 parts of aluminum.

A solution for such plating should consist of the following:

Sulphate of zinc	1½	pounds
Chloride of zinc	4	ounces
Sulphate of alumina	4	ounces
Water	1	gallon

Anodes should be as above mentioned. Voltage 4 to 6 volts.—C. H. P. Problem 2,043.

Q.—Can you tell us the reason of: in an electro-galvanizing tank why one load should turn out very well coated and the next (although it has had the same time and the braume and current have been just the same) should barely have any coat at all?

A.—Your trouble does not appear to be caused by external causes or every load taken from the tank would be the same.

We are of the opinion that the solution becomes polarized when in constant use and the anodes may become coated. One or the other causes would retard the current acting as a resist and unless sufficient voltage and amperage was maintained constantly the deposit would vary under such conditions as noted. We would suggest that you test the voltage and amperage at the tank terminals while the bath is loaded. You will then be able to determine whether polarization occurs.

The following suggestions may overcome your trouble:

First—Increase the density of the solution by adding more metallic salts.

Second—Increase the voltage if below 8 volts.

Third—Agitate the solution. This may keep the anodes from coating over and prevent polarization.—C. H. P. Problem 2,044.

FLUXING

Q.—Please furnish us with what you consider the most reliable flux for brass and also the amount to use.

A.—Common salt is the most reliable flux and it is also the cheapest to use for brass. It should be put in the crucible at the beginning of the heat in the proportion of about one handful to every one hundred pounds of metal.—P. W. B. Problem 2,045.

HARDENING

Q.—What is the best metal to use to harden lead.

A.—Lead can be made hard by alloying with antimony in proportions varying from 10 to 25 per cent. For ordinary purposes 4 parts of lead to 1 part of antimony would form a suitable alloy.—P. W. B. Problem 2,046.

Q.—We are having considerable trouble when hardening our long reamers used for reaming holes in brass by warping in the tempering.

A.—To harden or temper a long reamer to keep it from warping, grip it in a pair of tongs and suspend the tongs and reamer by a piece of string twisted very tight. When the reamer is heated properly hold it suspended perpendicularly by the string, holding in one hand and preventing it from turning by an implement held in the other. It should be held over a tub or tank of cooling fluid, and when all ready it should be allowed to revolve dipping in the cooling fluid at the same time.

Long reamers, taps or any tool hardened in this manner will be practically straight.—P. W. B. Problem 2,047.

MELTING

Q.—What causes a nickel anode to be granular in consistency and filled with minute air holes, and how can this fault be overcome in the melting and casting of the nickel?

A.—The fact that the nickel anode is granular, and is filled with blow holes proves that the trouble is due to casting and more particularly to overheating in the fire.

Nickel should be treated very carefully when melted, and if it is melted in a crucible in an open fire it should be very carefully covered with a flux to prevent the formation of nickel oxide which causes the trouble in the castings. To this end amber or green bottle glass is as good as anything to be put on top of the crucible, as the glass forms a coating which prevents the formation of oxides. Of course charcoal should also be used generously.

We believe that the best way to melt nickel is to do it in large quantities in a furnace similar to a cupola, only a reducing flame is employed. However, with proper car there should be no trouble due to blow holes in melting in ordinary crucibles. K. Problem 2,048.

PLATING

Q.—Can you tell us how to nickel plate aluminum castings so as to stand the action of the salt water on vessels for two or three years?

A.—Aluminum castings are being plated with nickel very satisfactorily in the following manner:

The castings are polished and cleansed in the usual manner with benzine then immersed in a dilute hot solution of soda ash about ½ pound to each gallon of water and then into a clear nitric acid dip. From there to cold water and then into a solution consisting of 1 to 1½ pounds of biborate of soda, that is, common borax, maintained at not less than 180 degrees Fahr. From the borax solution they should be rinsed in boiling water and then direct into the nickel bath.

The nickel solution consists of the following:

Nickel sulphate	1 pound
Magnesium sulphate	6 ounces
Chloride of sodium	2 ounces
Ammonium chloride	4 ounces
Water	1 gallon

The solution is maintained at a temperature of 120 degrees. If the solution is agitated by the aid of compressed air injected from the bottom of the tank a heavy deposit of nickel can be obtained quite rapidly. The voltage should be from 2½ to 3 volts.—C. H. P. Problem 2,049.

Q.—Will you kindly advise regarding a cyanide copper solution? I have a cyanide copper bath in a lead-lined tank and my anodes turn the color of lead. Is this caused from the lining in the tank or due to the copper anodes, which I had made up in our brass foundry, and in making them up the foundryman used a dirty pot and a great deal of lead in the mixture. I have added cyanide to quite an excess, but my anodes still turn dark when not in use and it is very hard to remove it. Can you tell me what the trouble is?

A.—Your trouble is no doubt due to a small amount of lead or arsenic in the lead, which would have a tendency to discolor the anodes in a cyanide solution, causing a deposit by simple immersion upon the copper anode. The amount of lead or arsenic, if very small, would not injure the solution to any extent, although it is not very pleasing to have the anodes thus coated.

It would be advisable to remove the anodes when the bath is not in use. In this manner you will avoid the slight coating upon the anodes. We suggest that you add a little sodium bisulphite occasionally. This will help to keep the anodes clean.

Lead-lined tanks should never be used for cyanide solutions, especially warm solution, and when used for cold solutions should be lined with asphaltum. Wooden or iron tanks are preferable for the purpose and are the ones the most frequently used.—C. H. P. Problem 2,050.

Q.—Kindly advise me how to copper plate wax tubing.

A.—To copper plate a wax surface the following methods should be employed.

First—Coat the wax uniformly with ceylon graphite in finely divided form. This is frequently termed electro-typers or floated graphite. The graphite should be evenly applied with a soft brush, preferably badgers' hair brush. After the graphite is applied apply the conducting wires which should consist of soft copper wire.

Second—Prepare a concentrated solution of sulphate of copper and use cold. Immerse the waxed articles after the graphite has been applied in a shallow receptacle and while immersed in the copper solution sprinkle electro-typer's iron filings over the surface. This will produce a reduction of the copper on the graphite surface. After this operation wash in cold water and plate in the regular acid copper bath until sufficiently coated with copper. The acid copper bath should consist of the following:

Water	1 gallon
Sulphate of copper	1¾ pounds
Sulphuric acid	4 ounces
Black molasses	1 pound

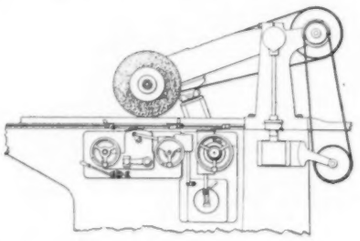
The voltage should be ½ to 1 volt and amperage in proportion to the surface of the article.—C. H. P. Problem 2,051.

PATENTS

REVIEW OF CURRENT PATENTS OF INTEREST TO THE READERS OF THE METAL INDUSTRY.

1,104,988. July 28, 1914. **Metal Reducing Machine.** B. M. W. Hanson of Hartford, Conn. Assignor to Pratt and Whitney Company of the same place.

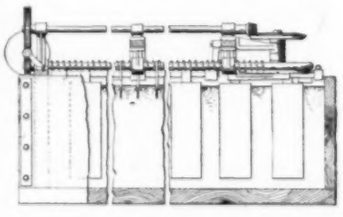
This invention relates to metal-reducing machines, among the principal objects of the invention being the provision of a machine of this character by which articles of various kinds can be quickly and accurately reduced.



A metal reducing machine, as shown in cut, involving the invention can be employed for various purposes for example for grinding areas or surfaces of different kinds. In this case the tool would preferably consist of a grinding wheel. In the machine there is a work-carrier and an oscillatory tool-carrier. The two carriers are preferably given a compound movement, consisting in the present case of two movements which have transverse directions; these movements may be considered as feed movements or motions provided to effect reduction of the stock. In addition to such compound movement or movements there is a third movement or an adjustment by which the amount or depth of cut can be regulated. The functions in question may be obtained in various ways. It is preferred that the feed movements as they have been considered, be accomplished in part by the work-carrier and the tool-carrier and that the adjustment movement be obtained through the tool carrier.

1,108,145. August 25, 1914. **Electro-Plating Apparatus.** John T. Daniels, of Newark N. J,, assignor to the Hanson & Van Winkle Company, of Newark, N. J., a corporation of New Jersey.

This invention relates to apparatus for subjecting articles to electro deposition or other electro chemical or chemical action.



Certain features of the invention are peculiarly related to electrolytic action in which the current must be passed through the articles being treated. It has heretofore been proposed to mechanically convey the articles to be plated through the electro plating bath. The purpose of such apparatus is to secure uniformity of plating and economy of operation.

The objects of the present invention are more especially to improve the support and conveyance of the articles through the bath so as to increase the efficiency or economy of operation, and these objects are attained by providing an intermediate support or bearing for the conveyer rods or screws and by sub-dividing the conveyer or screw into a plurality of lengths successively traversed by the article carriers, and by providing mechanism for transferring the article carriers from one length of the conveyer rod or screw to another.

An apparatus in which the principles of the invention are embodied is shown by way of example in the accompanying drawing.

1,106,107. August 4, 1914. **Method of Pickling Brass.** R. R. Parish, Waterbury, Conn., assignor to Chase Rolling Mill Company of the same place.

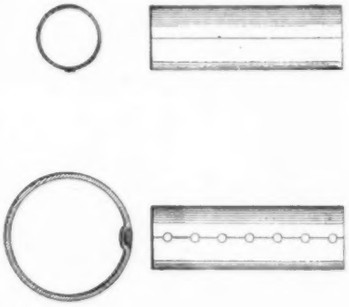
The invention covers a process whereby it is claimed to get rid of the annoying red streaks which commonly occur on pickled brass. The inventor states:

It is well understood in brass mills, that owing to a great variety of causes, superficial deposits of copper or copper oxids or both appear upon the brass during the successive annealing operations. Under perfect conditions of annealing, these objectionable deposits upon the brass do not occur, but they are so liable to occur, and so excessively difficult to control, that it is necessary to provide for removing them when they do occur in order to secure a product entirely uniform. The invention consists in introducing into a pickling solution, a sufficient amount of a per acid, or a derivative of a per acid, to aid the sulphuric acid in the solution in attacking and dissolving the objectionable surface disfigurements, whatever the character of the same may be. In practicing my invention, I may employ any suitable per acid or any suitable per acid derivative, such as per-sulphuric acid $H_2S_2O_8$, per-selenic acid $H_2Se_2O_8$, per-chromic acid $CrO_3H_2O_2$ or any of the salts derived from such acids. The amount of the per acid or per acid derivative used will be gaged according to the speed at which it is intended the pickling operation shall proceed. I have obtained good results by an amount of per acid or per acid derivative equivalent to about 10 per cent. of the sulphuric acid content of the pickling solution.

1,108,191. August 25, 1914. **Welded Tubing.** Laurence S. Lachman, of New York, N. Y., assignor to Universal Electric Welding Company, of New York, N. Y., a corporation of New York.

This invention relates to the construction of metal tubing.

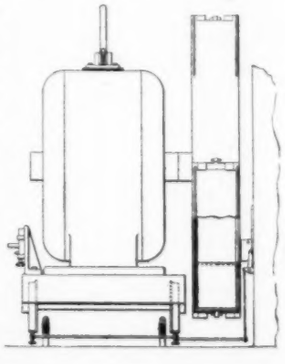
The object is to provide a novel construction of tubing, as shown in the cut, that will be substantially as strong as the previous constructions, having a continuously welded or brazed longitudinal seam. and that will have substantially as good a finish as tubing in which the longitudinal joint is composed of the abutted edges of the metal skelp or blank and which at the same time is capable of being readily and cheaply constructed.



1,109,572. September 1, 1914. **Casting Apparatus.** Bernard Gallagher, Lynn, Mass.

This invitation relates to apparatus for making castings, and more particularly to apparatus for making ingots of metal.

Molten metal as it comes from the furnace contains more or less gas which, if allowed to remain in the metal until it solidifies, forms bubbles or blowholes. One method of freeing the molten metal from gas is by the application of centrifugal force.

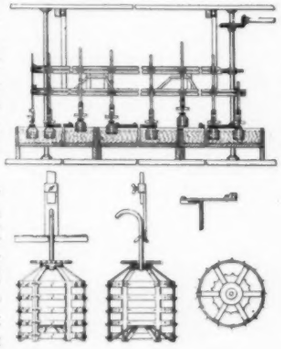


One object of the present invention is to provide new and improved means, as shown in the cut, for expelling gases from molten metal by this method. In accordance with this object one feature of the invention contemplates the provision of a rotating receptacle to receive the

molten metal. Mechanism is provided for automatically stopping the rotation of the receptacle after a sufficient length of time has elapsed to allow the metal to set.

1,108,410. August 25, 1914. **Electro-Plating Apparatus.** Elmer B. Stone, of New Britain, Conn., assignor to the American Hardware Corporation, of New Britain, Conn., a corporation of Connecticut.

This device relates to the class of apparatus used for electro-plating, and an object of the invention, among others, is to increase the production of apparatus of this class and at the same time maintain its efficiency.

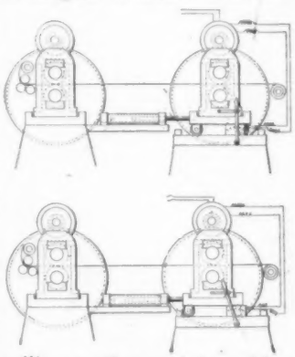


One form of device embodying the invention and in the construction and use of which the objects herein set out, as well as others, may be attained, is illustrated in the accompanying drawings.

The invention is especially applicable to an apparatus in which work holders are caused to travel in a predetermined path and during which travel articles carried by the holders are subjected to treatment in baths of different character contained in different tanks or vats, the latter being disposed in a path curved more or less and underlying an endless chain by which the holders are carried.

1,109,885. September 8, 1914. **Rolling-Mill or Similar Installation.** William R. Webster, of Bridgeport, Conn., assignor to Bridgeport Brass Company, of Bridgeport, Conn., a corporation of Connecticut.

This invention relates to metal working devices for operating on strips, bars, wires or other lengths of stock. The improvements are especially intended for application to metal working devices arranged in tandem for simultaneous operation upon successive portions of a length of stock fed from one of such devices to another of the same, but certain features of the invention may be used to advantage in other connections.



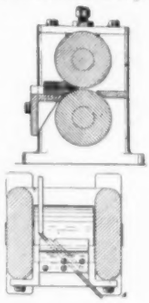
One of the primary objects of the present invention is to provide improved means, as shown in the cut, for regulating automatically the relative speeds of two or more rolling mills or other metal working devices arranged in tandem so as to maintain a practically uniform tension in the stock between the mills. More particularly, the inventor aims to provide an installation in which one of the rolling mills or other metal working devices is movable toward and away from the other by variations in the tension of the stock, and wherein this movement is utilized to control automatically the speed of a prime mover which drives one of the mills. It is also proposed to furnish a metal working device which is bodily movable on its foundation and so arranged with respect to a speed controlling device for a prime mover, that the speed of said prime mover will be varied in accordance with the tension of the stock acted on by said metal working device.

1,110,493. September 15, 1914. **Process for Treating Anode Residues.** Edward Keller, Perth Amboy, N. J.

In accordance with the present invention the anode residues which have been freed from liquid in a filter press or by other known means, are treated with concentrated commercial sulphuric acid, preferably in quantity sufficient only to convert the copper content into sulphate of copper when the residues are heated to a high temperature, the heating being necessary to complete the reaction and reduction of copper to soluble form or sulphate of copper without the employment of an excess of acid which latter if employed would make the mass a liquid mass in which silver and impurities would be dissolved or rendered soluble. Subsequent treatment of the residues consists in extracting the sulphate of copper, preferably by dissolving the same with hot water, giving a neutral and comparatively pure solution, which may be returned to the electrolytic copper depositing tank and the decopperized portion of the residues treated in a furnace and refined until sufficient purity is attained for the formation of doré bars.

1,110,000. September 8, 1914. **Metal Working.** David B. Marwick, of New Britain, Conn., assignor to the Stanley Works, of New Britain, Conn., a corporation of Connecticut.

The invention relates to that branch of the art of metal working wherein the size or shape, or both the size and shape of a length of stock is changed by passing the stock between a pair of reducing rolls, the stock being either hot or cold.

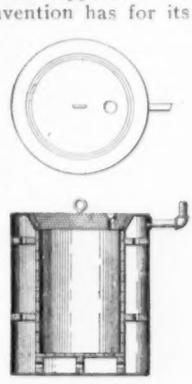


The invention has been developed in connection with a cold-rolling process.

The invention provides means, as shown in the cut, for varying the width of the product without varying its thickness. That is to say, given two pieces of stock of identical size and cross sectional shape, it is possible by this process to reduce these pieces of stock to a product having the same thickness but different width, by passage through the same pair of reducing rolls.

1,110,122. September 8, 1914. **Method and Apparatus for Annealing Metals.** F. H. Fechtig, Wilmington, N. C.

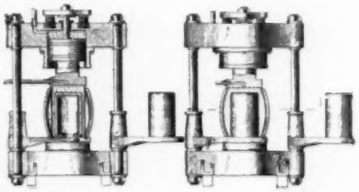
This invention relates to a method of and apparatus for annealing metals of all kinds, and the invention has for its object to provide for the annealing of such metals by causing them to cool more slowly than has been heretofore possible with the method and apparatus commonly used, with the result that the metals are annealed evenly throughout and are tougher and stronger than metals annealed by the methods commonly used.



With these objects in view the invention consists in the method and apparatus shown in the cut.

1,111,198. September 22, 1914. **Apparatus for Shaping Metal Articles.** Frederick G. Wacker, of Chicago, Ill., assignor to Charles H. Wacker, of Chicago, Ill.

This invention relates to the art of shaping hollow metal articles by means of suitable fluid pressure applied to the interior thereof for expanding such articles against a die or mold.



One object of the invention is to provide a new and improved apparatus, as shown in the cut, for so shaping metal articles, in which such an article is heated preliminarily and before the pressure is applied, thereby taking the chill off the article and rendering it less liable to breakage or rupture, the heat being applied through the body of water within the hollow article in case hydraulic pressure is the power or pressure employed.

Another object is to materially reduce the cubical contents of the interior of the article, leaving just enough space for the expanding fluid pressure to act upon the walls of the article, thereby materially reducing the amount of fluid employed, such as water in case hydraulic pressure is utilized.

EQUIPMENT

NEW AND USEFUL DEVICES, MACHINERY AND SUPPLIES OF INTEREST TO THE READERS OF THE METAL INDUSTRY.

MELLEN ROD CASTING MACHINE

By Richard C. Patterson, Jr., E.M.*

Those engaged in the wire and metal industry await with interest the coming introduction of a new invention for the manufacture of rods from brass, copper, aluminum and other metals directly from the melting furnaces, in any commercial length, size or shape. The Mellen Continuous Casting machine, invented by Mr. Grenville Mellen, of Llewellyn Park, New Jersey, eliminates the present elaborate system of producing castings for rod and wire. By Mr. Mellen's process but one operation is necessary. The machine receives the highly heated liquid metal at one end, molds and solidifies the same within, then delivers it in the form of rod at the other end in any required length. From here it is taken to the bull-block, where it is drawn down to specifications and made ready for shipment. Wire thus drawn has been found upon test to be of the very highest quality, as regards tensile and tortional strength and other requirements.

1. Cost of casting wire bar.
2. Cost of handling wire bar from molds.
3. Cost of rehandling wire bar to and from reheating furnace.
4. Cost of reheating.
5. Cost of rolling at rod mill (in the case of sizes ¾-inch and smaller).
6. The consequential cost by way of loss from oxide scaling during heating and rolling operation.

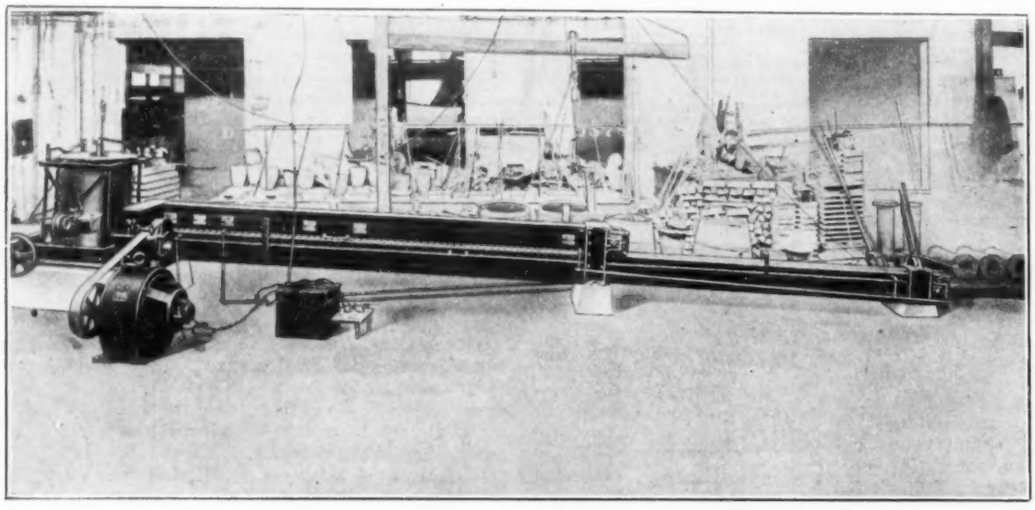


FIG. 1. THE MELLEN METAL CASTING MACHINE.

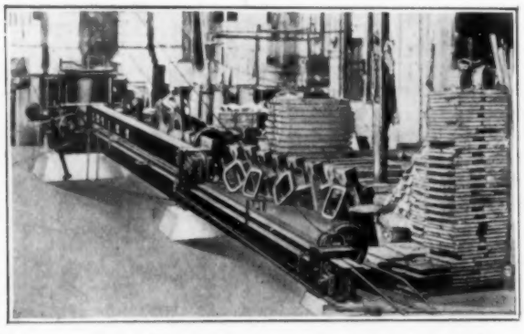


FIG. 2. A COMPARISON BETWEEN EXISTING EQUIPMENT FOR PRODUCING ROD AND WIRE BILLETS AND THE MELLEN MACHINE.

The steps of the old method which are eliminated by the use of this machine are as follows:

The items of investment eliminated may be numerated in the following manner:

1. Investment cost of means for the above said handlings.
2. Investment cost for the heating furnace.
3. Investment cost for the rolling mill.
4. Investment cost for the power plant.
5. Cost of excessive space and buildings.

The means for doing the above work is a simple machine which occupies an operating space of approximately 150 square feet. The machine is anything but complicated, the inventor having in mind simplicity, knowing that any type of workmen may be called upon to operate the same. The construction consists of a framework, composed of channel and angle irons to maintain in operating position two endless chains of mold blocks.

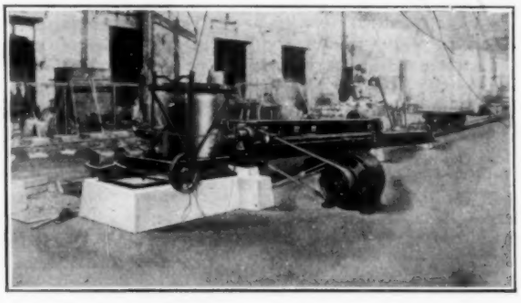


FIG. 3. ANOTHER VIEW OF THE MELLEN MACHINE.

*Mining Engineer, 323 Produce Exchange, New York City.

in sections, which blocks join in centre allignment in a straight line. These mold sections co-operate to complete the traveling mold orifice into which the liquid metal flows, and wherein, as above stated, it is molded, passing from the liquid into the solid state while in motion, and finally delivered in the form of a rod. The chains being endless, the rods may be produced continuously at the further extremity of the machine as long as liquid metal is fed in at the opening.

The economic effect of this invention is such that it must be felt throughout all the divisions of the metal industry, and if this machine continues to show the rapid development and advancement that it has in the past three months, all rolling operations for the production of small-size rods and wire, together with their large and expensive power equipment, must become unnecessary. The heating furnace, the function of which is to heat the metal bars in preparation for the rod-rolling process, will no longer be used. The great drain by the power plant on the coal supply will be stemmed, as the power required to operate the machine is approximately only 5 horsepower; also the excessive space required by a rolling mill is done away with by this machine, which actually occupies but 150 square feet.

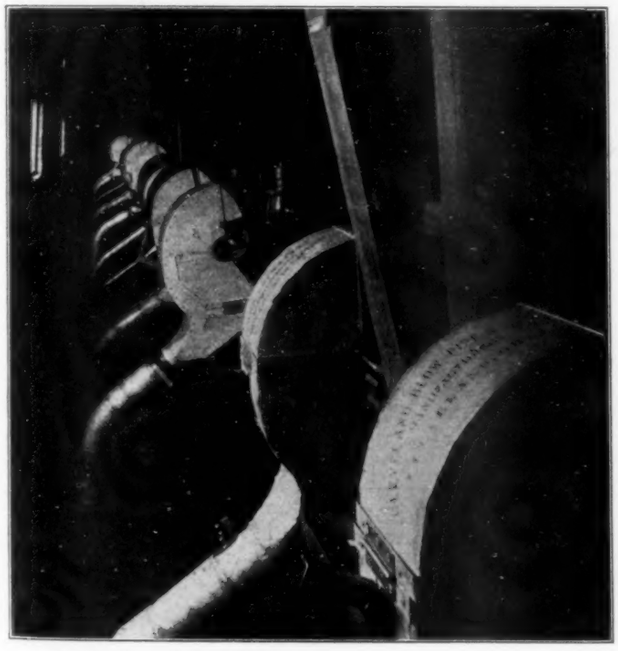
Another very important factor, which is not given the proper consideration, but which is far more important than some people seem to think, is the entire abolishment of danger to human life. The labor charge is reduced to approximately 5 per cent. since the only work needed is supplied by the caster.

In a short time the present tax for the refining of every pound of electrolytic copper will be reduced; this means when the invention shall be employed in the casting of symmetrical anodes. There is no reason in evidence why this machine should not be applied successfully to the many forms of steel production such as rods, structural steel, etc. It can thus be seen that rod, wire, plate and sheets will become cheaper.

Mr. Mellen has broad patent protection covering his invention both in this country and abroad.

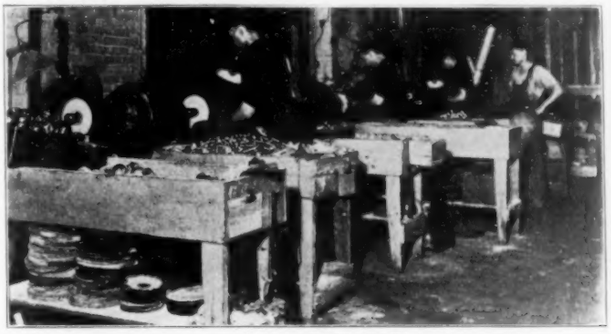
EXHAUST SYSTEMS

In the September number of THE METAL INDUSTRY the announcement was made of how the Cleveland Blow Pipe and



A TWENTY-FOUR POLISHING LATHE DUST COLLECTING SYSTEM INSTALLED AT THE MAPLE CITY MANUFACTURING COMPANY'S PLANT, MONMOUTH, ILL.

Manufacturing Company, 2096 West Third street, Cleveland, Ohio, was pleased with the reports of the various State Labor Departments on the success of their exhaust systems. The accompanying pictures show a notable installation of an exhaust system made by this company. This is an equipment of twenty-four polishing lathes, with complete fan dust collector hoods and



EXHAUST SYSTEM FOR SOLDER BENCH FUMES INSTALLED BY THE CLEVELAND BLOW PIPE AND MANUFACTURING COMPANY, CLEVELAND, OHIO.

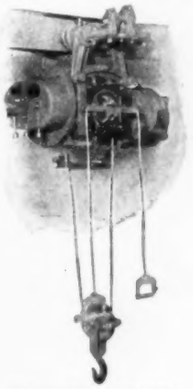
pipings and solder fume exhausts for the Maple City Manufacturing Company, Monmouth, Ill.

Another system lately installed for the Fort Pitt Malleable Iron Company, of Pittsburgh, Pa., was for a complete dust collecting apparatus, consisting of twenty-eight emery wheels, 24 inches in diameter. The hoods for these wheels were made of No. 12 iron, one-eighth inch thick. Ordinarily similar hoods are made of one-sixteenth inch galvanized iron, the principle of Safety First was considered of prime consequence. Hence the extra thickness of the hoods to hold securely any possible breaks of emery wheels. The wheels themselves were completely enclosed except the small opening for grinding purposes.

Besides exhaust and dust collecting systems, the Cleveland Blow Pipe and Manufacturing Company install ventilation systems, and as mentioned in our September number, their work is being accepted by and commented favorably upon by the various State Departments of Labor.

FOUNDRY ELECTRIC HOIST

The electric hoist shown in the cut is known as the "Type D" portable hoist and is designed for locations that require the hoists to be suspended by a single hook and also where it can readily be moved from place to place. The manufacturers of this hoist, the Northern Engineering Works, Detroit, Mich., state that it is found to be a great labor saver in those places where a hand hoist has formerly been used, as its speed is many times greater, occupies but little more space and uses but a small amount of current. Either direct or alternate current can be used and it can be provided, where necessary, with a variable speed controller. The manufacturers claim this hoist has the fewest parts and is the most durable hoist of its weight of any spur-geared hoist now on the market.



ELECTRIC HOIST.

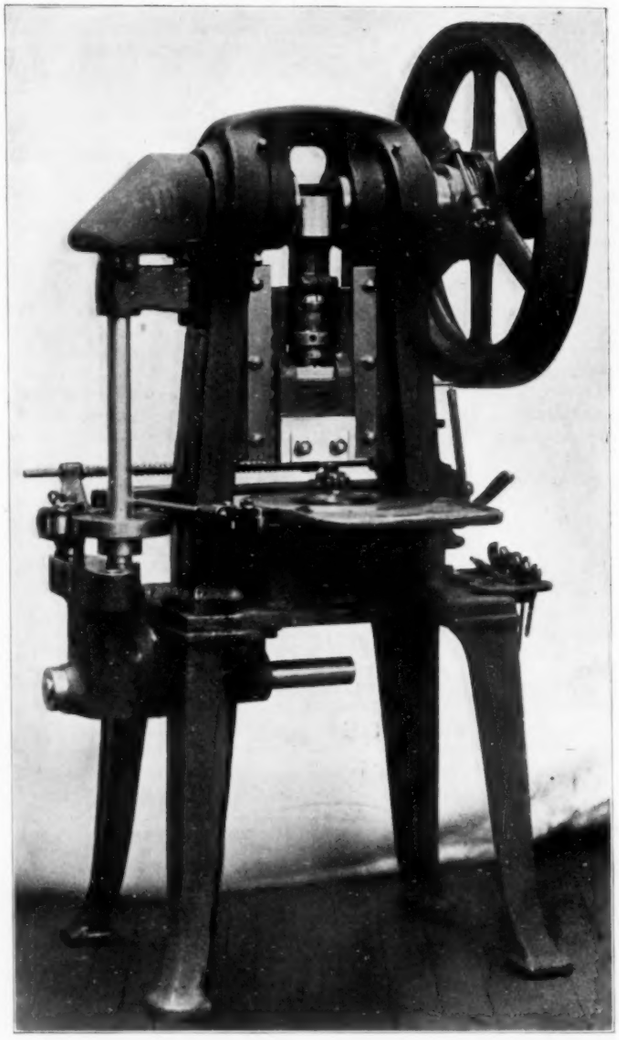
The Northern Engineering Works also make a line of "B" type cranes on which these hoists can be used. Descriptions and illustrations of the hoist will be found in Bulletin 541, which will be sent upon request.

MULTI-COLOR LACQUERING

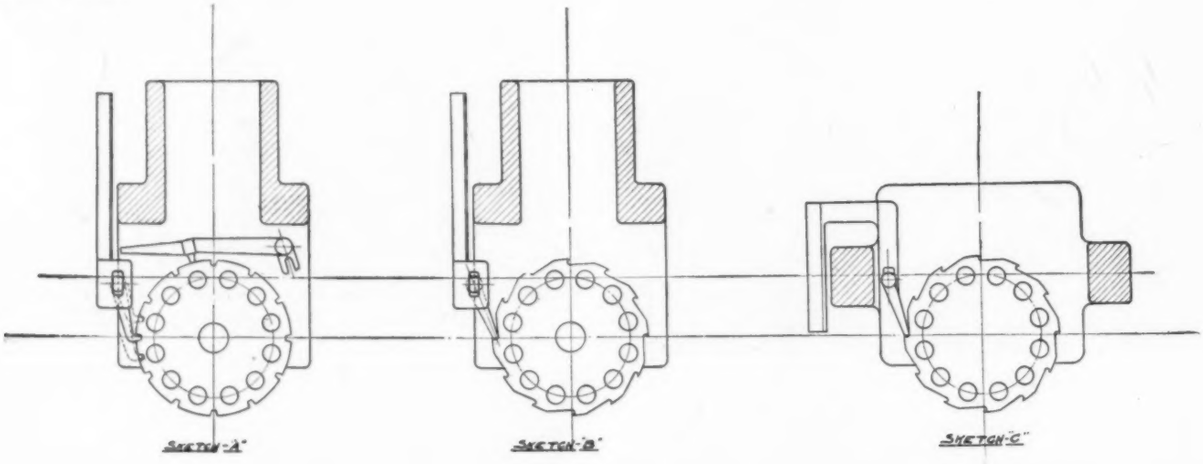
W. J. Smart, president of the Eureka Pneumatic Spray Company, New York City, states that he is the originator of a process for multi-color lacquering described in THE METAL INDUSTRY, September, 1914. Mr. Smart states that his claims for a patent covering this process have been allowed, and he proposes to ask a reasonable shop license for the use of it. He requests that THE METAL INDUSTRY take this opportunity to forewarn the trade, who may be interested in this process.

NEW LINE OF RATCHET AND FRICTION DIAL PILLAR PRESSES

The Waterbury Farrel Foundry & Machine Company of Waterbury, Conn., are bringing out a new line of pillar presses with ratchet dial and friction dial attachments, which have some novel features for which patents have been applied for. For a better understanding of the advantages claimed for the ratchet dial attachment we will describe the usual method of operating a dial press. Referring to sketch "A," Fig. 1, the usual arrangement is to have the operating pawl mounted on a slide moving in a straight line and the gauging notches in the dial are shaped the same as a rack tooth; that is, 29 degree included angle. With this construction it is impossible to fit the pawl so that it fits the notch in the dial at all points of the stroke, the pawl having a rocking motion with relation to the dial, also there being a tendency when the pawl draws back to draw the dial back with it. This is usually overcome by putting on a locking lever which is a friction lock held in by a spring and is not positive, so that the dial is kept from overfeeding by a friction at the center of the dial. Various devices have been installed with a dial of this kind to stop the press if the dial does not register exactly, but they are very delicate in their adjustments and liable to get out of adjustment through the jar of the press, thus making them fail to act at the proper time. For drawing through work a round notch is often used with no lock whatever, this construction being shown in sketch "B." The application of a dial feed to a pillar press, while perhaps not unmechanical, is as usually built extremely awkard in design, as the usual method is to have the back end of the die slide hook around the upright of the press, thus bringing the pawl inside the upright of the press. This construction is shown in sketch "C." The general appearance of the machine is shown in Fig. 2, and it will be noted that all gears are well guarded and that machines are furnished with table for holding the work, also shelf on the side for holding the usual wrenches that are furnished with the machine. The machine is controlled by a hand lever on the side, or a foot treadle can be used without any change in the controlling mechanism. There are no particular novel features in the friction dial attachment with which the machine is equipped excepting that it is so arranged that work can be either carried through the dies or brought up by the knockout, so that it can be knocked from the top of the dies, a knock-off attachment being furnished for this purpose. As is well understood by Press users, a friction dial machine, while useful only for one operation and only for round work can be operated at a very high rate of speed and by very cheap help, as the only thing necessary is for the operator to set the work right side up on the dial. Four sizes of these machines are being constructed in the so-called short stroke machines, this line being supplemented by four other patterns practically the same excepting that they can be furnished with long stroke. The smallest size has a 22-inch diameter flywheel, the largest size a 42-inch diameter flywheel and the two largest sizes can be furnished either plain or geared.



THE WATERBURY FARREL FOUNDRY & MACHINE COMPANY'S **NEW PILLAR PRESS.**



SKETCHES SHOWING THE OPERATION OF THE RATCHET AND FRICTION DIALS OF THE NEW PRESS.

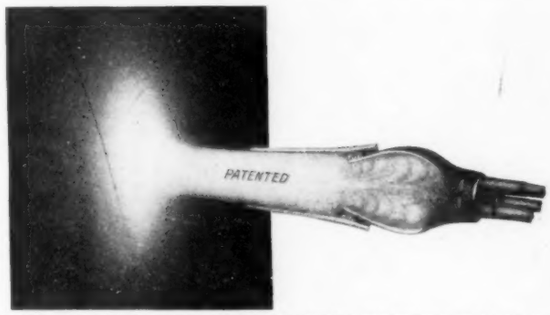
PORTABLE FOUNDRY TORCH

The torch shown in the cut is known as the Mahr Patent Torch, that has been designed by the Mahr Manufacturing Company, Minneapolis, Minn., for use in foundries for the following purposes: drying molds and ladles, cupola lighting, core patching and pre-heating for repairing defective castings.

The Mahr Company states that this torch will light instantly upon opening the valves regardless of whether the nozzle is hot

THE MAHR PORTABLE PATENT FOUNDRY FORCH.

or cold and without pre-heating or coaxing of any kind. It is also said that perfect combustion is obtained and after lighting the flame will not go out without closing the valves. This perfection in combustion is obtained by use of the Mahr double chamber nozzle in which the vapor is discharged from the atomizer into the first chamber, as shown in cut, Fig. 2, where it ignites. This burning vapor, in passing through the choke



THE METHOD OF OBTAINING PERFECT COMBUSTION IN THE MAHR TORCH.

into a second chamber, draws in free air through the auxiliary air openings, causing a perfect burning mixture and a steady compact flame.

The No. 3 torch shown in the cut, Fig. 1, is suitable for all foundry purposes, burns either crude or kerosene oil, and is furnished with interchangeable straight and elbow nozzles, and operates with compressed air at pressures from 5 to 125 pounds.

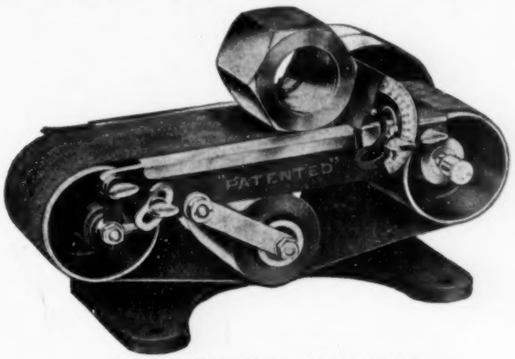
Further information may be obtained by addressing the Mahr Manufacturing Company.

NEW SURFACE GRINDING MACHINE

In presenting the latest development in surface grinding or polishing of metals in the Linisher horizontal machine, shown in the cut, the manufacturer does so with perfect confidence that it will fill a long felt want in the metal trades for grinding or polishing surfaces of all metals, as well as wood, rubber, fibre and celluloid.

It is claimed to be so simple in its operation and mechanical detail that ordinary help, or even boys, can turn out work as satisfactory or more so than a practical workman at a fraction of the cost of ordinary polishing methods. The Linisher, it might be said, is not a development from the ordinary disc grinder, horizontal or vertical surface grinder, but an evolution from these machines, as its numerous improvements to facilitate production will prove when its merits are investigated and which are as follows:

It is universal in its application; that is, it can be used on mild and hardened steel, cast or malleable iron, copper, brass and kindred alloys, papier mache, wood, bone, etc. The bands on the Linisher machine, whether of emery, flint, or garnet cloth, are woven in one continuous piece without any join whatever, so that there is no possibility of a band being destroyed through the joint opening and catching in the work. Every band can be worn down to the fabric, and a band can be put on and



THE LINISHER SURFACE GRINDER.

adjusted or removed in a few seconds without the use of any tool.

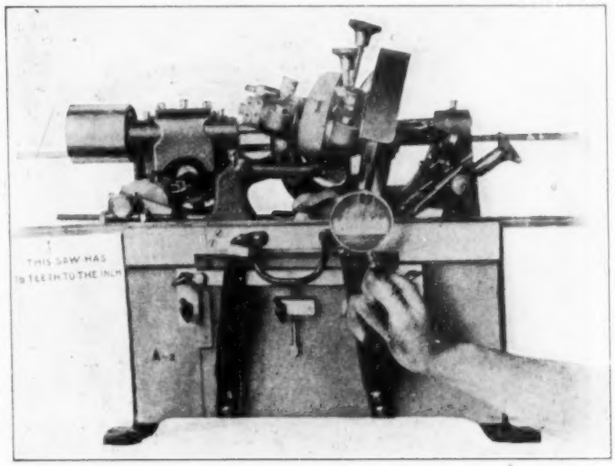
A great advantage over disc grinders is the freedom from glueing and clamping operations. Work of any size may be finished, as all parts are below the surface of the table with a belt drive.

Further information relating to prices and the agencies for this remarkable machine may be obtained from Callender & Co., Ltd., 61 Broadway, New York.

AUTOMATIC SAW GRINDER

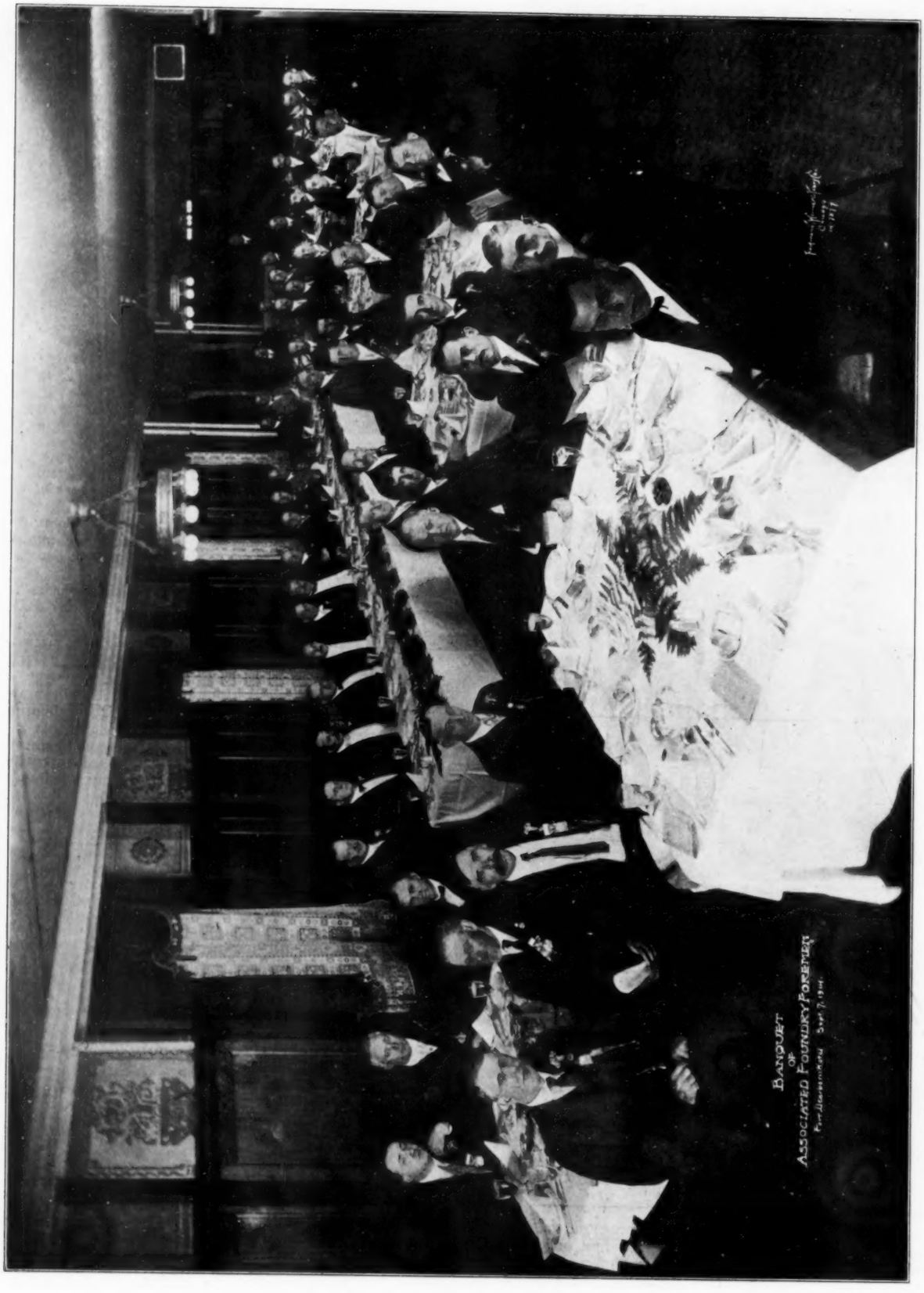
The Wardwell Manufacturing Company, 110 Hamilton avenue, Cleveland, Ohio, manufacture the automatic metal cutting band saw grinder shown in the cut and they claim that it is the only machine made that will regrind all metal cutting band saws, including the B tooth, such as are used for cutting steel, brass, bronze and aluminum, with teeth as fine as twenty to the inch.

The company states that it is possible, by means of this



THE AUTOMATIC SAW GRINDER OF THE WARDWELL MANUFACTURING COMPANY, CLEVELAND, OHIO.

machine, to re-sharpen saws that have previously been thrown away at a cost of from three to five cents each, thus reducing expense for saw equipment to less than one-third.



BANQUET OF ASSOCIATED FOUNDRY FOREMEN HELD AT FORT DEARBORN HOTEL, CHICAGO, ILL., DURING AMERICAN FOUNDRYMEN'S CONVENTION, SEPTEMBER 7-11, 1914. A COMPLETE DESCRIPTION OF THIS CONVENTION WAS GIVEN IN "THE METAL INDUSTRY" FOR SEPTEMBER, 1914.

Associations and Societies

REPORTS OF THE CURRENT PROCEEDINGS OF THE METAL INDUSTRY ORGANIZATIONS.

AMERICAN ELECTRO-CHEMICAL SOCIETY

This society held their twenty-sixth general meeting at Niagara Falls, N. Y., October 1 to 3, 1914. The sessions of the meeting were taken up by the reading and discussions of the following papers: "The Evaporator and the Power Problem in Electrochemical Plants," Otto Mantins; "On Electrometric Titrations," Henry Ziegel; "The Sources of Impurities in Cathode Copper," Lawrence Addicks; "The Constancy of Base Metal Thermocouples as Related to the Microstructure," O. L. Kowalke; "The Reproducibility of the Copper Electrodes," Frederick H. Getman; "The Electrolytic Determination of Nickel," W. Judson March.

A number of excursions had been planned by the arrangement committee and these were remarkably well attended. The feature of the meeting was the symposium held on Saturday, October 3, on "The Practical Side of Electrochemical Investigation," which consisted of a number of demonstrations of methods and apparatus. This symposium was held at the FitzGerald Laboratories, where excellent facilities were available which permitted a display of extreme interest and of very diversified character.

AMERICAN ELECTRO-PLATERS' SOCIETY

New York.—The regular monthly meeting of the New York branch was held on Friday, September 25, at the Broadway Central Hotel. After the regular business, general discussions were held on various subjects of interest to the plater, including the matter of testing chemicals used in the plating room in a simple and quick manner; electro-cleaning solutions and samples of nickel deposits on zinc die castings and nickel on steel were exhibited. The next meeting will be held at the above hotel on October 23.

PERSONALS

ITEMS OF INTEREST TO THE INDIVIDUAL.

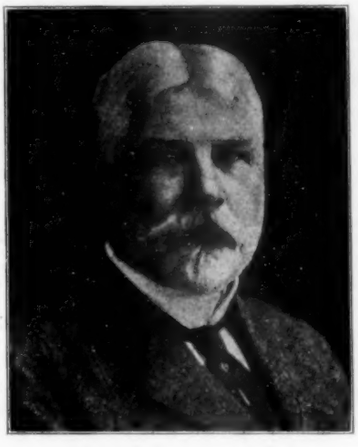
E. St. Elmo Lewis on the first of September became vice-president and general manager of the Art Metal Construction Company, whose factory headquarters are at Jamestown, N. Y. Mr. Lewis has been for the past ten years advertising manager of the Burroughs Adding Machine Company, of Detroit, Mich.

DEATHS

PHILANDER R. JENNINGS

Philander R. Jennings, senior member of the firm of Bruce & Cook, the oldest and largest dealers in tin plate, sheets and metals in New York City, died September 21 at his country home, Merrick, L. I., aged sixty-three years.

Mr. Jennings entered the employ of Bruce & Cook forty-five years ago and during his long connection with it served in every capacity from the bottom up, as has every other partner of the firm done since its founding in 1812. He was admitted to the firm in 1885. Mr. Jennings was a prime mover in all concerted movements looking to the betterment of the trade and invariably precided at its meetings and dinners. He was treasurer of the archdeaconry of the Long Island diocese of the Protestant Episcopal Church and a member of the Union League Club of New York, the Hamilton Club of Brooklyn, the Fulton Club of New York and other organizations, as well as a director of the Market and Fulton Bank, New York. The members of the firm of Bruce & Cook are now Frank C. Jennings, who becomes senior partner; A. Gardiner Cooper and August C. Pieper. He leaves a widow and two brothers, one of whom was associated with him in business.



PHILANDER R. JENNINGS.

WILLIAM G. DOIG

William G. Doig, Brooklyn, New York, of the American Brass Company, a man well known in the metal trade of New York City and vicinity, died at his summer home at Redding, Conn., on September 15, 1914. Mr. Doig's death was unexpected and came as a great shock to his family and friends. Mr. Doig was born in Brooklyn in 1860, and received his early education in the public schools of that city. As a boy he went West, where he spent a number of years. At the age of 21 he returned to New York and entered the employ of Benedict and Burnham Manufacturing Company of Waterbury, Conn., as a clerk in the New York office. Fifteen years ago he became sales manager of the brass department of this company in the Metropolitan district. At the time of his death Mr. Doig had completed 33 years of service for the Benedict and Burnham branch of the American Brass Company of Waterbury, Conn. He was a member of the Manhattan and other clubs of New York and elsewhere. He leaves a widow and two children.

FREDERICK A. THUM

Frederick A. Thum, mining and smelting engineer and superintendent for over twenty years of the Balbach Smelting and Refining Company, Newark, N. J., died, after a brief illness, at his home in Newark, on September 9. Although within a few days of his eighty-first birthday, Mr. Thum was in complete possession of his faculties to the last.

Mr. Thum came to this country from Germany in 1880 and took up his residence in Newark. He first worked as a consulting engineer and afterwards became superintendent of the entire Balbach plant. His retirement from active control took place seven years ago. The major part of his scientific training was acquired in German technical schools.

Mr. Thum leaves two sons, two grandchildren and a brother, George Thum, of Bayonne, N. J.

BUSINESS REPORTS OF THE METAL INDUSTRY CORRESPONDENTS AND TRADE ITEMS OF INTEREST FROM THE DIFFERENT INDUSTRIAL CENTERS OF THE WORLD.

NEW BRITAIN, CONN.

OCTOBER 5, 1914.

Reduced to a percentage basis the metal manufacturing conditions in New Britain at present and during the past month show just about .06 per cent of gain, .12 per cent of steadiness and .82 per cent of falling off. Thus, it is an actual fact that in this city during the month of September to every one factory that showed any gain in business conditions fourteen showed a decrease and but two have been able to hold their own. The time is now past when the manufacturers try to hide the falling off in their business, and one and all they admit that times are hard and trade is more slack than it has been for almost a decade. In the majority of instances it is not the lack of orders that has killed work, but it is the inability to get ready money. Some of the big concerns have fair sized orders coming in, but there is no cash with them, and without the coin of the realm it is impossible to keep the wheels of industry revolving. Added to these facts the fact that many of the concerns, notably the Stanley Rule & Level Co., has an enormous foreign trade, which, because of war conditions and the financial stringency abroad, has dropped away off, the factories are running on short time, and employees are being laid off in large numbers every week.

Several of the large concerns have already curtailed their factory expenses by laying off numerous hands and are now economizing on their office expenses by cutting down the salaries of their high priced clerks and foremen. The head of one large shop, who desires that his name be withheld from publication, has gone so far as to cut down his own salary twenty-five per cent. He was actuated to lead off with this reduction in salary, which he declares is caused by nothing except the actual business conditions as they are at present, as evidence that all hands should be concerned in it. He states that his plant has an unusually large amount of finished product on hand, about $400,000 worth, which is considered all that should be carried.

The American Hardware Corporation is at present working on a forty-five hour schedule, as are many of the other concerns, and the New Britain Machine Co., considered one of the most prosperous in the city, is not even doing as well as that, the management being compelled to cut the working time down to thirty-five hours per week, beginning with September 28. In all this city the only large metal using factory which has shown any signs of renewed prosperity is the Traut & Hine Co. For some time previous this factory had been running on a forty-hour schedule but during the latter part of the month business began to pick up and more orders came in, so that it was found necessary to go back onto the fifty-five hour schedule.

At a meeting held on September 23 the directors of the Union Manufacturing Company declared the usual dividend of 2 per cent., and the regular quarterly dividend and was also declared at the Stanley Works. The American Hardware Corporation has paid its quarterly dividend of 1½ per cent, but not one of the concerns are considering any extra dividends as a policy of strict retrenchment is being enforced in all quarters.

Some time ago the Union Manufacturing Co. made plans for the erection of a new five-story brick factory building and have even gone so far as to raze the wooden factory which was on the site of the proposed addition. Now, however, the directors have made the statement that the building of this addition will have to be postponed for a short time, owing to the present conditions brought about by the war, but as soon as the business atmosphere clears up they will proceed.

Some of the far-sighted men in this city, however, are looking for a prosperity boom within the next ninety days, and to strengthen their argument they state that about eighty-six per cent of manufactured articles used by the South American countries have been manufactured in Europe. Now this trade is cut off and, should the war end tomorrow, it would take a couple of years to resume operations abroad. Thus, they argue, the South American nations will soon be looking to the United States to provide that which they are unable to procure abroad, with the result that the metal manufacturers will reap a golden harvest.—H. R. J.

HARTFORD, CONN.

OCTOBER 5, 1914.

The general business depression, brought about by the method of handling public affairs and the legislation passed by the party now in the ascendency in Washington, together with the European war situation, has resulted in a period of stagnation for many of Hartford's big metal working concerns. Money is by no means easy here, and this, with the scarcity of orders, due to an apparent nation-wide policy of waiting for a brighter horizon, has caused slack time in nearly all of the factories. Many of the Hartford metal-working concerns depend upon Europe for some raw materials, and these face complete closing within a few weeks unless something happens abroad to relieve the situation.

To relieve the situation presented by about 5,000 workmen who are on such short time that their wages are entirely inadequate and another 2,500 who can find no employment, the merchants', manufacturers' and charity organizations of the city have taken up consideration of relief measures. There will be no more help in the form of charity than is absolutely necessary, but a large loan fund will be created, and workmen out of employment and in need of funds will be given an opportunity to borrow from this. Recommendations that married men be given preference in employment and that hours of labor be reduced rather than parts of factory forces laid off have been favored by those working out the problem which faces Hartford at this time.

Liu Tsching En, director general of the Hanyang arsenal, near Hankow, China, has arrived in Hartford to become familiar with the big arsenal being constructed for the Chinese government by the Pratt & Whitney Co. of this city. With him came his wife and ten assistants. The Chinamen were sent here by their government to spend a year at the Pratt & Whitney plant, remaining here until the arsenal is finished and ready to ship to China. B. M. W. Hanson, works manager of the Pratt & Whitney Co., is supervising work on the Chinese contract. The arsenal will cost the Chinese republic about $1,250,000. The contract was received by the local concern early in the summer.

Connecticut is in the midst of a state political campaign. Governor Simeon E. Baldwin, democratic governor, is the nominee of his party for United States Senator. The Republican party has named Senator Frank B. Brandegee. The campaign promises to eclipse all previous ones, and the fight will be based principally upon the record of the present administration, as its low tariff, banking and currency and anti-trust legislation and agitation have affected Connecticut industries. Full state tickets have been named by all the parties.

Connecticut does not take kindly to the "Buy-a-bale-of-cotton" movement, being organized to help the South, which, besides being hit by the European war, is feeling some of the effects of tight money which has resulted from democratic reign. Connecticut newspapers are suggesting that some kind friend start a "Buy-a-machine" movement to aid the manufacturers of New England in the crisis.

The Billings & Spencer Co. has bought the factory formerly occupied by the Columbia Motor Car Co. and abandoned by the Maxwell Motor Co. some months ago. The Billings & Spencer factory will be moved gradually into the new plant, the entire work to take about a year.

Both the Underwood Typewriter Co. and the Royal Typewriter Co. are on short schedule, due to the interruption of the foreign market for typewriters. Both concerns have set about creating an additional American demand to make up for the shortage and put the plants back on their usual schedules.

Full time was resumed recently by the John Underwood & Company factory, makers of adding machines. The plant went on short time at the outbreak of the European war because of the foreign market condition. Up to that time, the concern had devoted much of its selling attention to France, Germany and Italy. Since then the home market has been developed.

The Pope Manufacturing Co., to all practical purposes, has gone out of existence, though the company still has a legal status in Connecticut. Under an order of the court, Colonel George Pope, the receiver of the company's Connecticut assets, is selling the machinery and other property of the company. The manufacture of products stopped some weeks ago. The splendid factory buildings of the company will be put on the market soon. The Pope company will continue the manufacture of products at its Westfield, Mass., plant.—A. L. M.

BOSTON, MASS.

October 5, 1914.

There is little change in the metal industries in Boston. Most of the shops here reflect the general business situation in New England, which is hopeful, rather than active. The manufacturers in jewelry lines, especially those who make platinum settings and similar products, are rather quiet, the increased price of the raw material having some adverse effect upon the general market. It works in two ways, however. Higher prices for the output serve to stimulate the exclusive trade, which is willing to pay well for articles that are not likely to come within the reach of the ordinary purchaser, while at the same time they check the normal demand.

Brass workers, especially those who are purveyors to the building trades, are having a fair business, and the platers, in nickel and silver especially, while they could comfortably do more, are not complaining very much. Chandelier manufacturers have fair orders from city and suburbs. There is a large amount of new construction work ahead for Salem in rebuilding the burned portion of the city, and Boston concerns expect to share in the distribution. It is stated that more than $1,000,000 worth of work of this sort is under way already in that city, which means that good orders for interior fittings of metal will be obtained here.

The chief comment regarding the outlook by members of the trade is to the effect that buying is almost always for immediate needs rather than in anticipation of future wants. By some this is regarded as a condition conducive to stability, although the majority of dealers prefer a market that takes its tone from a more speculative impulse, saying that such a market at least has the merit of a keenness that is lacking to a great extent this year.—B.

ATTLEBORO, MASS.

October 5, 1914.

General business conditions in Attleboro have shown a decided improvement over the past few months, although at the present time they do not approach the flourishing state of some previous seasons. This has been a year of considerable hardship to the manufacturers and workers in this district, the result of the country wide depression in nearly all forms of industry being felt here to a great extent. When a slight improvement in conditions began to show itself the manufacturers sent their salesmen on the road with the hope of fanning the faint spark of business into a flame which would keep the fires of Attleboro's industries burning continuously and would forecast an ever-welcome return to prosperity. Orders have begun to come in and shops which have been hard pushed to remain open during the summer are now running full time with the immediate prospect of night work to keep up with the orders.

The free evening vocational school, a new venture for the town, and one which if present indications are fulfilled, will be a success, will start this month in the high school building. The school will be under the supervision of the state board of education, and is for the benefit of the jewelry workers. All the tools and machines necessary for the school have been supplied by local manufacturers. The school is open to all boys or young men employes of the shops upon the condition that they pursue the same branch at which they are working during the day.

George Simmonds, for the past eight or nine years connected with the W. E. Richards Company as one of the principal stockholders, has sold out his interest to R. M. Horton, who by this move acquires practically entire control of the company. Mr. Simmonds retired because of ill health.—C. C. C.

NEWARK, N. J.

October 5, 1914.

All metal lines are slow, and although this is the logical time to do business, as the foreign competition is cut off, still things are not very good.

The Ewell-Smith Company, Ordway Building, manufacturers of metal novelties, has bought out the Lippincott Steam Specialty Manufacturing Company, manufacturers of plumbing goods, and also the Hutchinson & Boyd Company. They have also installed a machine shop to make their own tools.

C. Western has taken over the business of Ahr & Day, of 9 Willard street, manufacturers of brass goods, metal novelties and stampings.

The U. S. Surgical Instrument Company, of 67 Hamilton street, manufacturers of brass, platinum and nickel goods, have discontinued business.

The Schultz Manufacturing Company has been started at 54 Lawrence street, by A. J. Schultz. The firm will manufacture brass trimmings for metal beds, dies and tools, brass novelties, etc.

John Hetherington, of the New Jersey Screw Works, has started a factory at 129 Oliver street, to manufacture metal novelties and screw machine productions.

The H. S. Wyckoff Company has moved their factory from 69 Arlington street to 269 Broome street, and have now over 4,000 square feet of floor space. The company is making several new lines of platers' supplies and chemicals, and have materially increased the business.

The American Oil & Supply Company are handling the Craige polisher and hand buff for jewelry, silverware and cut-glass work.—H. S.

LOUISVILLE, KY.

October 5, 1914.

Reports from the various local metal working concerns with reference to business conditions at the present time are more diversified in their tone then seems reasonable. While expressions entirely optimistic are heard from one shop, another shop which has, in the past, been getting its share of the business, reports no business whatsoever. The only logical explanation of this situation obtainable was voiced by one of the local leaders of the trade, who stated that Louisville metal workers had in the past depended too much upon distillery work and had in addition confined their efforts even in this line to the State of Kentucky alone. As had been previously stated a number of times, Kentucky distillers are not proceeding with a confidence that carries with it expending money in improvements and additions to their plants. The result, as far as the metal workers of Louisville, and Kentucky, are concerned, is obvious.

Although Louisville is not a large cotton center, the present cotton situation has had its effect upon all business, and even, though few are willing to admit an actual depression, a spirit of conservatism is pronouncedly prevalent. Rather than make any improvements and with a view of increased output, the Kentucky manufacturer is contenting himself with his present equipment and maintains a defensive rather than offensive attitude.

Thomas Hines of Hines & Ritchey, one of the leading local shops, reports the firm has on hand all the work that can be taken care of and reports that present indications point to a very successful season. The principal work demanding the attention of Hines & Ritchey is the installation of two new stills of a type recently patented by the firm, this type being their third and latest model. The firm recently contracted with the

owners of a distillery, being installed in Florida, for the still required and other equipment. The other job involves installation of an additional still in the plant of one of the old and established distilling firms in Arkansas that is planning to increase its output. It is interesting to note that the company increasing its capacity is doing so on account of the feeling of sympathy toward prohibition in other states, realizing that curtailed manufacture of liquor in one state must necessarily increase the business of the distilleries in the states where prohibitive legislation is not in effect.

C. J. Thoben, who together with Elmore Sherman, operates the Vendome Copper & Brass Works, recently returned from an extended trip through the State where, it is understood, he called upon a number of distillers. The mission of Mr. Thoben, it is reported, was not only to call upon his clients with a view of soliciting business but also to obtain direct information as to the intentions of the distillers with reference to curtailed output and its probable duration. Mr. Sherman, of the same firm, is in New Orleans looking after the interest of the Vendome Company in a new distillery that is being installed there. He will probably return about the middle of October.

As a result of the present hostilities in Europe and the consequent lack of importations, the zinc industry in Tennessee is becoming more formidable every day. The possibilities in this line as long as the war continues are tremendous. The recent increase in the price of the product may act as a kind of high protective tariff that will put the zinc mining industry in Tennessee on a solid and competitive basis. Substantiating this argument, the Journal and Tribune, of Knoxville, quotes from a recent report of the United States Geological Survey, which hints that by the time the war closes the United States will be exporting zinc to European, South American and Asiatic markets.

Zinc operations in and about Mascot, Tenn., have been more than doubled since the first official declaration of war, August 5. At Embreeville, Tenn., operations are beginning, and it was even reported a smelter would be installed at this point. Those interested, however, abandoned this plan on account of the outlay of money necessary, and a mill is to be installed instead.—G. D. C., Jr.

JAMESTOWN, N. Y.

October, 5, 1914.

Hultzern & Jones Brothers, of the Acme Plating Company, have moved their plant to 23 East First street.

The Interior Metal Manufacturing Company, manufacturers of steel, brass and bronze furniture, doors, trims, etc., will enlarge its factory to increase the capacity 10 per cent. They will also probably put in a plating and polishing plant, and are putting in more benches.

The A. F. Oliver Gear and Machine Company, manufacturers of die stamping and metal working machinery, have moved to 60 Cherry street.

S. D. Stouner has taken control of the Art Brass Manufacturing Company, manufacturers of brass goods, chandeliers, etc.

F. W. Fairbank is making bronze tablets and plates at 1074 North Main street. He made the bronze tablets for the Hall of Philosophy and for the Sherwood memorial music hall at the Chautauqua Grounds.

BUFFALO, N. Y.

October 5, 1914.

Metal conditions in this city and vicinity are beginning to improve. Money is a bit tight and some of the banks are raising their rate of interest. Nevertheless the war has aroused enthusiasm in the hearts of the finished metal producers. They are anxious to spread out their arms of trade into foreign lands, and particularly in South America. The local Chamber of Commerce has been actively engaged in the awakening of local concerns to be up and alive to meet this unusual trade opportunity which has bowed before the people of the United States since the outbreak of the clashing of arms which is being staged in Europe. Everywhere the slogan is "Made in America."

Some of the local finished line producers have not had such good times in years. Take the George Ray Manufacturing Company, for example. They have booked up orders that will keep all their hands busy for the next six months, something which they never experienced before. The Zero Valve and Brass Company last month put out one order alone which amounted to 1,500 feet of brass railing, and they still have a good share of orders on their books.

The electro-platers have been very busy within the last three weeks and with a very bright future. Everybody is working full force. The only ones who is suffering to some extent are the supply houses and particularly for the want of certain chemicals. But with a little hard work they are able to supply the needs of local electro-platers. And it is only a question of a short time when supply houses will be entirely supplied by American chemical manufacturers.

Local foundries are the only branch of the metal trades which has not come up to the standard or normal conditions. This, foundrymen hope to see take place within the next month or so. Yet some of the foundries are booking up some fair-sized orders. Take the American Bronze Company, for example, they have just received an order for three sets of pasteurizer castings ranging from 5,000 to 6,000 pounds each.

The Titan Copper Products Company, Inc., which has just changed hands, is doing a fine business with Mr. Allen Kendall as president and general manager. Mr. Kendall is of long experience in the brass and babbit foundry business, and among the good standard policies which he will inaugurate, one is this, as he states it: "It is our intention to make castings at our plant in strict accordance of specifications and chemical analysis as ordered by our customers. We want everyone to be a satisfied customer. Therefore we are going to give them what they want."

The Luman Porcelain Metalware Company, incorporated in Buffalo within the last month, is soon to break ground to construct a one-story steel-brick structure, 85 x 105 feet. The company is capitalized at $20,000 and will manufacture household utensils. The incorporators are William C. Luman and Gretchen Luman, of Cambridge, Mass., and Thomas M. Luman and Adelaide Cox Luman, of Buffalo.

At a recent annual election of the U. S. Hame Company, Buffalo, the following new directors were elected: Fred Frazer, Syracuse, N. Y.; W. S. Carr, Andover, N. H.; I. G. Rowell, Manchester, N. H.; W. C. Houck, Buffalo, N. Y.; J. A. DeArmond, Cincinnati, O.; C. F. Herrmann, Tell City, Ind.; H. J. Turner, Hamilton, Ont., and R. P. Carr and Proctor Carr, of Buffalo, N. Y.—G. W. G.

The use of aluminum by automobile manufacturers has become pretty general during the last few years, but there is only one firm that uses cast aluminum exclusively in building their car bodies. This is the Pierce-Arrow Motor Car Company, of this city. Its use at first was confined to dashes, seats and doors and it was thought that the pure aluminum could not be cast so thin and the adding of other metals made it too heavy. Later experiments showed that pure aluminum could be successfully cast in any size and as thin as one-eighth of an inch or thinner. This made it possible to make bodies lighter than the sheet metal construction by casting, and this kind of a body was found to have many advantages over any other material.

The Lion Silverware Company was incorporated to manufacture metal ware and jewelry at Galt, Ont., Canada.

Fleckinger Brothers Company, of Bradford, Pa., contemplate increasing its capital stock from $75,000 to $150,000, and moving to Ellicottville, N. Y., where they will build a foundry and machine shop.

Frank Pare, who conducts a plating business in the Terrace Building, have moved to Babcock street. He will also manufacture small hardware.—H. S.

COLUMBUS, OHIO

October 5, 1914.

The metal market in Columbus and central Ohio is quiet to the extreme. There is scarcely any demand and quotations all along the list are irregular. In fact, it is almost impossible to secure prices as they vary so suddenly when prices are given. The general European war is having a demoralizing effect on all metals and as a result little trading is reported. This condi-

tion is expected to prevail until the war situation is cleared up and the metal exchanges resume.

The demand for copper is very small and the movement in this territory is limited. There are no quotations available on any kind of copper. The same conditions prevail in the brass market. In aluminum there is a slight demand but prices are ruling low and unsteady. Babbitt is not in good demand. Other metals are in about the same condition.

The Cleveland Aluminum Casting Co. has been incorporated with a capital of $10,000 to manufacture aluminum castings, by J. W. Lovell, G. F. Newton, H. O. Yoder, Jane Scott and N. G. Scherer.

At Bellaire, Ohio, the American Stamping and Enameling Co., which conducts the Enterprise & Novelty plant is arranging to erect a $200,000 addition to the plant.

At Ashland, Ohio, Paul Maiwurm, head of the Maiwurm German Aluminum Co., reports a contract entered into with the Bowman Co. of Cleveland to furnish $200,000 worth of goods yearly. This contract as well as others made by the company recently will require additional facilities at the plant.

The Ohio Valley Enamel and Stamping Co. of Bellaire, Ohio, has been incorporated with a capital of $10,000 to manufacture cooking utensils, by M. L. Blackburn, B. A. Leister, W. A. Stellers, M. R. Bissell and W. T. Hedges.—J. W. L.

CINCINNATI, OHIO

October 6, 1914.

While there are not lacking signs that business among metal workers is picking up, the trade as a whole is still in the middle of the extremely slow spell caused by the sudden outbreak of European hostilities. Perhaps the majority of the larger metal shops in Cincinnati supply the numerous machine-tool concerns in the city; and as the large export business normally handled by the machine-tool trade has been almost totally cut off by the situation in Europe, that branch of industry has been unable to dispose of anything like its ordinary output, and is correspondingly dull. The demand for the various fittings usually furnished by the brass foundries is therefore down to a very low point. Other branches of the metal industry here, less important in volume, but usually active, are likewise finding little to do. The coppersmiths, who furnish equipment for the brewers and distillers, have found the early fall season abnormally dull, due to the tendency of the liquor trade to await the result of the November election on the prohibition question before making any repairs. The distillers usually overhaul their plants and install such new equipment as may be necessary before starting operations in the fall, but there has been very little work from this source this season, for the reason indicated. The general state of the trade locally, therefore, is not especially prosperous just now; but, as indicated, indications point to an early resumption of activity all around, with the expected readjustment of American industries to the situation, and this means business for the metal workers.

Manager Bergheim, of the Edna Brass Manufacturing Company, reported recently that the slow business experienced by local machine tool manufacturers has resulted in cutting down that concern's business to a low point, but that the company is going after work energetically, with favorable prospects for landing it. "There is every reason to hope that things will liven up soon," said Mr. Bergheim. "Business was just on the verge of recovering from the depression of the past year when this war came along and knocked it out again; but it is only a question of a short time when we get a line on the numerous opportunities opened up to American industry by the war, and that will bring more and better business than ever."

In the recent reorganization of the D. T. Williams Valve Company, one of the largest manufacturers of steam fittings in Cincinnati, D. T. Williams retired as president of the company, being succeeded by Robert E. Mullane, who has been treasurer of the corporation for some years. Francis X. Pund was elected vice-president of the concern. Mr. Mullane states that tentative plans for the enlargement of the plant have been discussed, although the work will probably not be undertaken before next spring.

The Cleveland Aluminum Casting Company, organized at Cleveland, Ohio, with a capital stock of $10,000, will manufacture aluminum goods. J. W. Lovell and others are interested in the company.—K. C. C.

DETROIT, MICH.

October 5, 1914.

Unsettled conditions are reported in all lines of the metal industry in Detroit and throughout the State. No one is able to make a forecast acceptable to manufacturers, but nevertheless practically all plants are in operation, although they are considerably below normal. The European war is blamed for everything, and as that catastrophe apparently is due to spread over a long period of time, manufacturers are uneasy and looking about to remedy conditions, along different lines of procedure than were followed prior to the conflict over the seas. Detroit manufacturers are going after the trade in South America, and already have undertaken a strenuous campaign. One of the first to look to the South for an outlet is the Burroughs Adding Machine Company, a concern that uses much brass and aluminum in the manufacture of its products. Within the last two weeks a special representative has been dispatched from the headquarters in Detroit, with instructions to open up a more extensive market in South America.

Manufacturers of plumbing supplies and valves are not over-blessed with orders, although they report a moderate business and that conditions are no worse than a month ago. They are, however, much below that of one year ago at this time. No improvement is expected until late in the winter.

Detroit's mainstay at present is the automobile plants. The majority of these are operating on a curtailed scale, but are giving employment to thousands of men who might otherwise be idle. The Ford Motor Car Company at the present time has a pay roll of about 12,000. The Studebaker corporation apparently comes next with 6,000 or 8,000, and the Cadillac with 4,000 or 5,000. The city is being flooded with men from other cities, but a plan is under way to induce employers to engage only Detroit residents, so as to keep men out of the city who, it is believed, will become a burden on the community during the coming winter.

One encouraging feature in the brass and aluminum industry is the fact that none of these concerns have failed during the last several months. There have, however, been a number of disasters in other lines of business. This is some indication that the industry is holding its own and will weather the depression successfully.—F. J. H.

CHICAGO, ILL.

October 5, 1914.

The metal industry in Chicago is in very indifferent shape; it is dull, consumption is not more than 60 per cent. of normal. One of the principal reasons for lack of business is the high price of money. All the railroads need a great deal of steel for extensive improvements, but they cannot afford to pay the high rate of interest demanded by the banks. Prices are fairly well maintained. As the railroads use more than 60 per cent. of steel in the industry directly or indirectly, when they are not able to secure the money to cover purchases, it is easy to understand why the metal industry is as quiet as it is.

Business in brass and copper is dull, reports W. H. Meyst, of the De Forest Sheet & Tin Plate Company, whose offices are located at 38 South Dearborn street, Chicago. "The raw copper that is mined in this country," he continued, "determines the price, and on account of the European war there has been very little export trade, and as a result raw copper is weak at this time. Because of this condition manufacturers of metal products anticipate lower prices and are holding off. In addition to this, on account of the money situation it is practically impossible to finance large deals. This is particularly the case with railroads." The factory of this company is located in Detroit, Mich., running regular schedule time. The factory is at present two weeks behind in its orders.

In connection with the electro-plating industry it is claimed the electrotypers use larger quantities of copper and lead than electroplaters. Many of the electrotypers found a slump in business the last two months on account of concerns that have not the capital to continue their advertising campaigns and had to "cut it out," while large concerns continued realizing that by continued advertising they are getting increased business.

On account of the "dry" wave going over the country, breweries are not making extensions to their plants, and it is also difficult to finance the erection of new breweries. This materially reduces the consumption of heavy sheet copper, making the demand of copper less and prices weaker.

Conditions in the tin plate and sheet steel fields are excellent, said A. R. Johnson, district manager for the Follansbee Brothers Company, who had recently returned from their mill in Follansbee, W. Va., stating that the mill was running full time and full force. In Chicago, however, business is rather quiet. It is not as brisk as it was last month, nor does it compare favorably with that of last year. Throughout the country the volume of business is fair and prospects good. This concern states that it feels it will run its mill full force right along. As the Follansbee Brothers Company specialize in high grade material, it does not follow necessarily that it reflects the conditions in the tin plate industry generally.

F. P. Smith, of the F. P. Smith Wire & Iron Works, at 56 West Lake street, one of the largest concerns in Chicago in the line of iron and bronze work for building, said: "Business is much depressed this month; more so than it has been for a year. Collections are bad and orders coming in very slowly. Our factory is running fifty-four hours a week with a reduced force of 60 per cent. The outlook is not good this fall."

The Aluminum Company of America, with offices at the Westminster building, Chicago, reports that business is fair and find no dropping off in the demand. The company gets its supply of alumina from their mines in Arkansas, where the best grade of alumina in this country is found. Their factories at Niagara Falls, Messina, N. Y., and Marysville, Tenn., the latter completed only the early part of this year, where the metal aluminum is produced, are all running on regular schedule time.

J. T. Potter, of the Standard Aluminum Company, 110 South Dearborn street, Chicago, which manufactures a full line of aluminum utensils and specialties, stated that conditions were fair and demand good. Their factory and rolling mill, located at Two Rivers, Wis., where they produce their own sheets, runs full time and full force.

A representative of the Imperial Brass Manufacturing Company, at 1200 West Harrison street, summed up the situation in the metal industry in Chicago as follows: "In the builders' hardware line, business is normal, as many buildings are finished at this time of the year, and we are running our plant full time. General business in the metal industry is slow, but there are indications that it is picking up, but it is not quite as brisk as last month. On the whole, however, we found business good for the year. Manufacturing specialties hold their own. We had to cover a larger field to get the same volume of business we had last year. The automobile business is not up to the standard. From inquiries received for next year's requirements it indicates the automobile industry will give us as much business as we had this year. Our output is about the same as last year. This output consists of brass, bronze, aluminum and kindred metals. The tendency in the copper field on part of manufacturers of specialties has been to hold off on account of the European war situation."

The Hewitt Manufacturing Company, 80 East Jackson boulevard, Chicago, manufacturers of brass castings and journal bearings, finds not much demand and has few inquiries. Its factories in Chicago, Milwaukee, St. Louis, with six other factories scattered through the East and South, are all running light. Business is reported to commence picking up some in the last ten days.

The Chicago Bronze Company, 110 West Lake street, are probably the heaviest importers of bronze powders west of New York. They handle all bronze powders for making paint which are made in Germany. L. W. Cohn, its manager, said: "We have not been able to get any goods from Germany since the war broke out. We have a large stock on hand, sufficient to last us a year. Prices have advanced 25 per cent. and are still going up. The demand is very good just now, as everybody is stocking up in anticipation of higher prices. These powders are used for metal products and decorating purposes of all description. Collections are only fair; the general trade does not expect much of a boom this fall. We lately have had inquiries for these powders from Japan, China, England and Canada; these countries formerly getting their supply from Germany before the war, but we have all we can do to take care of the domestic trade under present conditions. F. R. V. H.

NEWS OF THE METAL INDUSTRY GATHERED FROM SCATTERED SOURCES

The E. R. Caldwell & Son Brass Company, Syracuse, N. Y., have let the contract for the erection of a foundry and machine shop and expect to have the new plant in operation by October 15.

The National Brass Company, Grand Rapids, Mich., manufacturers of brass hardware, will erect an addition to their building, 64 x 160 feet. The company reports that they have placed orders for a new equipment.

The Geneva Cutlery Company, manufacturers of razors, Geneva, N. Y., is building a 40 x 70 foot addition to its plant. The new addition will give increased room in the machine shop, grinding room and polishing room.

The Delaware Foundry & Machine Company, Delaware, Ohio, are building a foundry. They will be in the market for foundry equipment such as blowers, tumbling mills and other equipment with which to make up a first-class modern foundry.

The Watson-Stillman Company, Aldene, N. J., has been awarded the contract for equipping the hydraulic shields to be used in boring the new East River tunnels, New York. Each shield will require seventeen jacks. The contract involves upward of $100,000.

W. J. Lynch, superintendent of the National Enameling and Stamping Company, Granite City, Ill., announces that the company's St. Louis rolling mill plant at Second and Destrehan streets, St. Louis, Mo., which has been idle for two years, resumed work on August 31.

The Flint Metal Specialty Company, 1800-1810 Beach street, Flint, Mich., has acquired 12,000 feet of manufacturing floor space and has installed equipment for the manufacture of auto sheet metal parts. The company will add to its equipment as the business requires.

The Ohio Brass Company, Mansfield, Ohio, report that they do not contemplate manufacturing in Canada at the present time. It was recently reported that this company had been incorporated in Toronto, Canada, to manufacture brass goods, iron, etc., and at a capital of $40,000.

The Union Metal Works, Inc., Chelsea, Mass., manufacturers of plumbers' supplies, which was incorporated under the Maine laws, have re-incorporated under the Massachusetts laws. The company is incorporated for $50,000 and the incorporators are J. H. Carr, John H. Carr and F. J. Carr.

The New York University will offer this year a course in trade journalism. The class will meet on Monday evening at six o'clock in the University Building, Washington Square, New York, N. Y. A bulletin of the Department of Journalism explaining the proposed course will be mailed to any one interested.

R. F. Lang, 8 and 10 Bridge street, New York, importer of the Royal brand of phosphor, manganese and silicon copper and phosphor tin, prepared nickel salts and hydraulic brass and bronze parts, reports that the trouble in receiving these goods from Europe has been overcome, and he is prepared to serve his customers as formerly.

The British Aluminum Company, Toronto, Ont., Canada, announce that they are maintaining their shipments of British

aluminum despite the shipping conditions prevailing from the European war. The company also mentions that they have on hand very large stocks of metal both at New York and Toronto, and are, therefore, ready to make prompt shipments.

The Pinney & Boyle Manufacturing Company, Los Angeles, Cal., have secured a site on Santa Fe avenue extending from Fifty-first street to Fruitland avenue, and are erecting a building to cover a space of 300 x 300 feet, which will be of structural steel covered with corrugated iron. The plant will be equipped with traveling cranes and other machinery, and will be used as a tin products manufacturing plant.

Logemann Brothers Company, Milwaukee, Wis., well known manufacturers of baling presses, cabbaging machines, hydraulic presses and pumps, have removed to their new plant, Thirty-second and Burleigh streets. The new plant has been specially built for the construction of their products. The plant is a model and occupies two and one-half acres, and they will add to their already extensive line of baling machines.

Hefner & Maysilles, Grafton, W. Va., have completed a building for a foundry and machine shop at a cost of $10,000. This company is in the market for a 42-inch cupola with full iron and brass foundry equipment, pattern shop equipment and the following for the machine shop: 24-inch shaper, 20-inch x 10-foot lathe, bolt and pipe threading machine, hydraulic wheel press, 150-ton, and also some small machine tools and hand tools.

The Sullivan & Kelley Plating Company, of Davenport, Iowa, has been purchased by the Western Pattern & Manufacturing Company, Moline, Ill., and will be moved to Moline. Considerable new equipment for the Moline plating plant has been purchased since the consolidation of the two concerns and it is now supposed to be one of the largest manufacturing concerns of its kind in the West. The company will manufacture the Kelley gas iron and, in fact, do all kinds of light manufacturing.

INCORPORATIONS

Business organizations incorporated recently. In addressing them it is advisable to include also the names of the incorporators and their residence. Particulars of additional incorporations may frequently be found in the "Trade News" columns.

To deal in old and new metals.—William Rosenblatt, Inc., New York, N. Y. Capital $25,000. Incorporators: C. Rosenblatt, W. Rosenblatt, New York, and A. Mandel, Far Rockaway, N. Y.

To manufacture aluminum boxes, containers, screw caps, etc.—Aluminum Container Company, Fulton, N. Y. Capital $100,000. Incorporators: L. W. Emerick, Claude E. Guile and N. L. Whitaker. The company will take over the plant and equipment of the Fulton Specialty Company, which went into the hands of the receiver.

FOREIGN TRADE OPPORTUNITIES

[In applying for addresses at Bureau of Foreign and Domestic Commerce, Washington, D. C., refer to file number.]

No. 13781. Metal powder.—An English manufacturer reports that he wishes to communicate with American manufacturers of gold bronze, aluminum powders and metal leaf. He states he is in a position to place large and regular orders for these materials.

No. 13885. Zinc dust.—A firm in the United Kingdom has advised an American consul that it wishes to purchase zinc powder or dust, a by-product of spelter. Quotations are desired c. i. f. destination in quantities up to 5 tons. Quotations should be accompanied by samples. The firm has submitted samples of the material desired. It is stated that the firm in question is prepared to pay cash against documents. The samples of the dust may be had on application to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or to any of its branch offices.

INQUIRIES AND OPPORTUNITIES

Under our directory of "Trade Wants" (published each month in the rear advertising pages), will be found a number of inquiries and opportunities which, if followed up, are a means of securing business. Our "Trade Want Directory" fills wants of all kinds, assists in the buying and selling of metals, machinery, foundry and platers' supplies, procures positions and secures capable assistants. See Want Ad. pages.

PRINTED MATTER

Die Castings.—"Die Castings in White Metal," a bulletin just issued by the Doehler Die Casting Company, Brooklyn, N. Y., describes and illustrates interesting die cast work, explains the possibilities of the die casting process and the economies of using die castings and enumerates the facilities of the Doehler company for prompt service.

Tramrail Equipment.—The Whiting Foundry & Equipment Company, Harvey, Ill., have issued catalog No. 111, giving complete descriptions and illustrations of their overhead tramrail systems. The various parts of these systems consisting of switches, turntables, trolleys, hangers, clamps, etc., are well described in the bulletin which, together with prices, will be sent upon request.

Metal Cyanides.—The Roessler & Hasslacher Chemical Company, New York, N. Y., announce that they are about to issue a new booklet descriptive of copper, zinc and silver cyanides. This booklet gives receipts and directions for the use of these salts and also points out that the main economy derived from their use is caused by the elimination of two-thirds of the platers' cyanide consumption, a saving which must certainly appeal to the plater in these times of shortage of cyanide. Copies of the booklet will be mailed upon request.

Heating Information.—The W. S. Rockwell Company, furnace engineers and contractors, New York, N. Y., have issued a hanger, 9¼ x 11¼ inches in size, suitable for hanging in a laboratory or furnace room. The hanger contains considerable data of value in connection with heating operations and comparative scale of Fahrenheit and Centigrade thermometers, together with a list of hardening and tempering heats is contained on one side; while the other side sets forth the facilities of the Rockwell Company for solving the furnace problems.

Milling Machine.—The Brown & Sharpe Manufacturing Company, Providence, R. I., has issued a book entitled "A Practical Treatise on Milling and Milling Machines." An effort has been made to treat the subject in as non-technical a manner as possible and to present information that will assist the beginner and practical man to a better understanding of the care and various uses of modern milling machines. Instructions on the erection and care of the machines are given, together with notes on indexing and cutting spirals. There are over 120 pages of tables for indexing, approximate angles for cutting spirals and all the leads that can be obtained with any possible combination of the change gears furnished with the universal machines of the company. The book is bound in heavy paper and cloth covers, the price for the two styles being $1 and $1.50, respectively.

Foundry Management.—The Wentworth Institute, Boston, Mass., have issued a catalog for 1914-1915, describing in detail the new developments which the Institute under A. L. Williston, principal, is planning. One of the important new courses which has been added to the curriculum of the Institute is a two-year course in foundry management and opera-

tion. This course is designed to train the young man so that he will be able to advance rapidly and take charge of preparation of machines and the design of labor-saving devices, to direct the mixing and melting of metals, to assume the responsibility of core departments or direct the testing of metals in the physical and chemical laboratories. We would advise that it would be greatly to the advantage of any young man desirous of obtaining technical instruction along these lines to get in touch with Principal Williston.

Carlsruhe Cleanser.—James H. Rhodes & Company, 85 and 87 Front street, New York, and 162 West Kinzie street, Chicago, Ill., who are large distributors of plating supplies, etc., have published a very interesting little booklet on their Carlsruhe Cleanser, entitled "The Foreman's Handbook." This booklet contains useful information on the cleansing of metals and will help to solve many of the problems encountered by the electroplater, such as how to avoid poisonous fumes, white deposits, discolorations, etc. Also it gives specific instructions for the use of Carlsruhe in the treatment of stove hardware, chandelier, electrical appliances, polished brass, enameled and stamped ware, aluminum, white metal castings, pewter, steel, and so forth. The booklet is particularly interesting at this time, as this material for cleansing metals entirely eliminates the use of potash, which is considerably higher in price since the European war. It will be sent, upon request, to any who are interested.

CATALOG EXHIBIT

An exhibition of every kind of catalog may be seen at The Metal Industry office, 99 John street, New York. The Metal Industry is prepared to do all of the work necessary for the making of catalogs, pamphlets, circulars and other printed matter. Estimates will be furnished for writing descriptions, making engravings, printing, binding, for the entire job from beginning to end or any part of it.

METAL MARKET REVIEW

NEW YORK, October 5, 1914.

COPPER.

The business, during September, with home consumers has been fairly normal, that is as compared with the months of June and July immediately preceding the war. The mills in the "valley" are running at about the same rate as before the war.

Prices have held remarkably steady. Lake copper is quoted today at around 12¼ cents against 12¾ in early September. Electrolytic today 11¾ to 7/8 against 12⅜; and casting brands at 11⅝ to ¾ against 12¼ cents early September. This shows a decline of only about ½ cent per pound and shows pretty conclusively that the copper market is well under control.

The exports for the month will total close to 19,000 tons, or about 42 million pounds. This is considered very good under present conditions. France gets about 615 tons, Italy 500 tons, and England gets the balance. The heavy shipments to Holland during August, presumably for German account, have attracted the attention of the British government, and shipments of copper to Holland are now being held up. This action of the British government has been brought to the notice of Congress through a telegram to Senator Smoot from a German firm doing business in New York. A representative of this New York firm is reported to have said that had Holland one or two dreadnoughts the British government would never have interfered with this neutral nation's shipping. It is well known that Holland can not possibly need the copper and that its destination is Germany. In this connection it would not have been very much out of place to suggest to the German firm here in New York that, instead of appealing to the American Congress to help them get copper to Germany, a word to the German fleet to come out and protect their shipments of copper would be all that is needed.

There will be no statement by the Copper Producers' Association this month. All sorts of estimates are being given out, and from a well informed quarter the stock on hand today is given as from 175 to 200 million pounds.

TIN.

The price of pig tin in New York has gradually declined to around 30⅞ cents during the month. The arrivals have been fairly large, a little over 4,000 tons, and the deliveries are estimated at 3,600 tons, having a stock of tin on hand a little over 1,000 tons. The market has become just about normal again and prices are made each day in accordance with the cabled prices in the London market. The London Metal Exchange is still closed and also the New York Metal Exchange.

Price today of 5 ton lots spot around 31 cents, with October, November, December deliveries about ½ cent per pound lower.

LEAD.

The Trust price has been reduced 15 points to 3.75 New York, and the independents are taking orders at 3.70 for carload lots prompt shipment. The market is dull and consumers do not seem interested in future trading. The market in East St. Louis is quotable at 3.67½.

SPELTER.

The rapid advance to 6 cents early in August did not hold, and although the exports for the month of September total over 1,500 tons, nearly 1,000 tons going to England, prices here broke gradually and the market today is dull and weak at around 5⅛ to 5¼ New York.

ALUMINUM.

The market is very dull and quotable at 18¼ to 18¾ for 98 to 99 per cent. ingots.

ANTIMONY.

Prices have dropped about 4 cents a pound and the market has quieted down. Cooksons is quoted at 10½ to ¾, Halletts at 9½ to 10 cents, Hungarian grade 8½ to 9 cents.

SILVER.

The market has held fairly steady at around 24 pence in London and 52¾ cents in New York.

PLATINUM.

Prices are unchanged. Soft refined is quoted at $48 to $50 per ounce, with 10 per cent. hard at $52.

QUICKSILVER.

Market is easier again and more or less nominal at $50 to $60, a flask today against $75 a month ago.

SHEET METALS.

The quoted market prices are lower than a month ago, and on good business these figures can probably be shaded. Sheet copper is quoted at 17 cents base, copper wire at around 13 cents to 13¼, high sheet brass at 12¾ cents.

OLD METALS.

Market is very dull and prices for copper scrap are about ½ cent per pound lower than a month ago. All white metal scrap is lower and the market is weak.—J. J. A.

SEPTEMBER MOVEMENTS IN METALS

	Highest.	Lowest.	Average.
COPPER			
Lake	13.00	12.00	12.50
Electrolytic	12.35	11.75	12.15
Casting	12.25	11.60	12.05
TIN	38.00	30.85	32.80
LEAD	3.90	3.70	3.85
SPELTER	6.10	5.10	5.50
ANTIMONY (Hallett's)	13.00	9.80	11.20
SILVER	55⅜	51⅜	53.30

WATERBURY AVERAGE

The average price of Lake Copper per pound as determined monthly at Waterbury, Conn.:

1912—Average for year, 16.70 1913—Average for year, 15.83. 1914—January, 14.75; February, 15.125; March, 15.00; April, 14.875; May, 14.75; June, 14.375; July, 14.125; August, 13; September, 12.875.

COPPER PRODUCTION

The Copper Producers' Association have decided, on account of the unsettled state of the copper market, not to issue any statement of the stocks of copper for the month of September. The stocks of copper on July 1 were about 106,000,000 pounds. According to some estimates the stock of copper in America today is close to 250 million pounds, while more conservative estimates are around 170 million pounds. On the outbreak of the war the refinery output was to be reduced 50 per cent., and this must help considerably to keep future stocks almost normal.

Metal Prices, October 5, 1914

METAL PRICES.

	Price per lb. Cents.
COPPER—PIG AND INGOT AND OLD COPPER. Duty Free. Manufactured 5 per centum.	
Lake, carload lots, nominal	12.25
Electrolytic, carload lots	11.75
Castings, carload lots	11.65
TIN—Duty Free.	
Straits of Malacca, carload lots	31.25
LEAD—Duty Pig, Bars and Old, 25%; pipe and sheets, 20%. Pig lead, carload lots	3.70
SPELTER—Duty 15%. Sheets, 15%.	
Western, carload lots	5.15
ALUMINUM—Duty Crude, 2c. per lb. Plates, sheets, bars and rods, 3½c. per lb.	
Small lots, f. o. b. factory	24.00
100 lb. lots, f. o. b. factory	21.00
Ton lots, f. o. b. factory	18.50
ANTIMONY—Duty free.	
Cookson's cask lots, nominal	10.75
Hallett's cask lots	10.00
Hungarian grade	9.00
NICKEL—Duty Ingot, 10%. Sheet, strip and wire 20% ad. valorem.	
Shot, Plaquettes, Ingots. Blocks according to quantity .....38 to	.43
ELECTROLYTIC—3 cents per pound extra.	
MANGANESE METAL	.95
MAGNESIUM METAL.—Duty 25% ad valorem (100 lb. lots)	2.50
BISMUTH—Duty free	3.00
CADMIUM—Duty free	2.25
CHROMIUM METAL—Duty free	.75
COBALT—97% pure	2.00
QUICKSILVER—Duty 10%, per flask	$65.00
	Price per oz.
GOLD—Duty free	$20.67
PLATINUM—Duty free	50.00
SILVER—Government assay bars—Duty free	.52⅜

INGOT METALS.

	Price per lb. Cents.
Silicon Copper, 10%.....according to quantity	25 to 28
Silicon Copper, 20%..... " "	28 to 32
Silicon Copper, 30% guaranteed " "	30 to 34
Phosphor Copper, guaranteed 10% "	24 to 28
Phosphor Copper, guaranteed 15% "	25 to 29
Manganese Copper, 25%..... " "	25 to 29
Phosphor Tin, guaranteed 5%. " "	57 to 60
Phosphor Tin, no guarantee.. " "	36 to 39
Brass Ingot, Yellow..... " "	8 to 9½
Brass Ingot, Red..... " "	11 to 12
Bronze Ingot ..... " "	10½ to 11¼
Manganese Bronze Ingots.... " "	17 to 18½
Phosphor Bronze ..... " "	18 to 20
Casting Aluminum Alloys.... " "	16 to 18

PHOSPHORUS—Duty free.	
According to quantity	30 to 35

OLD METALS.

Dealers' Buying Prices. Cents per lb.		Dealers' Selling Prices. Cents per lb.
10.25 to 10.50	Heavy Cut Copper	11.75 to 12.00
10.00 to 10.25	Copper Wire	11.25 to 11.75
9.00 to 9.25	Light Copper	10.25 to 10.50
9.00 to 9.25	Heavy Mach. Comp	11.00 to 11.25
7.00 to 7.25	Heavy Brass	8.50 to 8.75
5.25 to 5.50	Light Brass	6.50 to 6.75
7.25 to 7.50	No. 1 Yellow Brass Turnings	8.00 to 8.25
8.00 to 8.50	No. 1 Comp. Turnings	9.00 to 9.50
3.25 to ——	Heavy Lead	—— to 3.50
3.50 to ——	Zinc Scrap	—— to 3.75
5.50 to 6.50	Scrap Aluminum Turnings	6.00 to 7.00
11.50 to 12.00	Scrap Aluminum, cast alloyed	12.00 to 13.00
13.00 to 14.00	Scrap Aluminum, sheet (new)	13.00 to 14.00
23.00 to 24.00	No. 1 Pewter	25.00 to 26.00
20.00 to 23.00	Old Nickel	20.00 to 24.00

PRICES OF SHEET COPPER.

BASE PRICE, 17 Cents per Lb. Net.

SIZE OF SHEETS. Width.	LENGTH.	64 oz. and over.	32 oz. to 64 oz.	24 oz. up to 32 oz.	16 oz. up to 24 oz.	15 oz.	14 oz.	13 oz.	12 oz.	11 oz.
		Extras in Cents per Pound for Sizes and Weights Other than Base.								
Not wider than 30 ins.	Not longer than 72 inches.	Base	Base	Base	Base	½	1	1½	2	2½
	Longer than 72 inches. Not longer than 96 inches.	"	"	"	"	½	1	2	3	4½
	Longer than 96 inches. Not longer than 120 inches.	"	"	½	1	2	3	5	7	
	Longer than 120 ins.	"	"	1	1½					
Wider than 30 ins. but not wider than 36 inches.	Not longer than 72 inches.	"	"	Base	Base	1	2	3	4	6
	Longer than 72 inches. Not longer than 96 inches.	"	"	"	"	1	2	4	6	8
	Longer than 96 inches. Not longer than 120 inches.	"	"	1	2	3	4			
	Longer than 120 inches.	"	1	2	3					
Wider than 36 ins. but not wider than 48 inches.	Not longer than 72 inches.	"	Base	1	2	3	4	6	8	9
	Longer than 72 inches. Not longer than 96 inches.	"	"	1	3	4	5	7	9	
	Longer than 96 inches. Not longer than 120 inches.	"	"	2	4	6	9			
	Longer than 120 inches.	"	1	3	6					
Wider than 48 ins. but not wider than 60 inches.	Not longer than 72 inches.	"	Base	1	3	5	7	9	11	
	Longer than 72 inches. Not longer than 96 inches.	"	"	2	4	7	10			
	Longer than 96 inches. Not longer than 120 inches.	"	1	3	6					
	Longer than 120 inches.	1	2	4	8					
Wider than 60 ins. but not wider than 72 ins.	Not longer than 96 inches.	Base	1	3	8					
	Longer than 96 inches. Not longer than 120 inches.	"	2	5	10					
	Longer than 120 inches.	1	3	8						
Wider than 72 ins. but not wider than 108 ins.	Not longer than 96 inches.	1	3	6						
	Longer than 96 inches. Not longer than 120 inches.	2	4	7						
	Longer than 120 inches.	3	5	9						
Wider than 108 ins., but not wider than 120 ins.	Not longer than 120 inches.	4	6							

The longest dimension in any sheet shall be considered at its length.

CIRCLES, 8 IN. DIAMETER AND LARGER, SEGMENTS AND PATTERN SHEETS, advance per pound over prices of Sheet Copper required to cut them from ..... 3c.

CIRCLES LESS THAN 8 IN. DIAMETER, advance per pound over prices of Sheet Copper required to cut them from ..... 5c.

COLD OR HARD ROLLED COPPER, 14 oz. per square foot and heavier, advance per pound over foregoing prices ..... 1c.

COLD OR HARD ROLLED COPPER, lighter than 14 oz. per square foot, advance per pound over foregoing prices ..... 2c.

COLD ROLLED ANNEALED COPPER, the same price as Cold Rolled Copper.

ALL POLISHED COPPER, 20 in. wide and under, advance per square foot over the price of Cold Rolled Copper ..... 1c.

ALL POLISHED COPPER, over 20 in. wide, advance per square foot over the price of Cold Rolled Copper ..... 2c.

For Polishing both sides, double the above price.

The Polishing extra for Circles and Segments to be charged on the full size of the sheet from which they are cut.

COLD ROLLER COPPER, prepared suitable for polishing, same prices and extras as Polished Copper.

ALL PLANISHED COPPER, advance per square foot over the prices for Polished Copper ..... 1c.

ZINC— Duty, sheet, 15%.

	Cents per lb.
Carload lots, standard sizes and gauges, at mill.....8.50 basis, less 8%	
Casks, jobbers' prices	9c.
Open casks, jobbers' prices	8½c.

Metal Prices, October 5, 1914

PRICES ON BRASS MATERIAL—MILL SHIPMENTS.

In effect October 1, 1914, and until further notice.

To customers who buy over 5,000 lbs. per year.

	Net base per lb. High Brass.	Low Brass.	Bronze.
Sheet	$0.12⅝	$0.14¼	$0.15
Wire	.12½	.14⅛	.15
Rod	.12½	.14⅞	.16
Brazed tubing	.17	——	.19¾
Open seam tubing	.17	——	.19¾
Angles and channels, plain	.17	——	.19¾

50% discount from all extras as shown in Brass Manufacturers' Price List.

NET EXTRAS FOR QUALITY.

Sheet—Extra spring, drawing and spinning brass	⅛c.	per lb. net advance
" —Best spring, drawing and spinning brass	1½c.	" " " "
Wire—Extra spring and brazing wire	⅛c.	" " " "
" —Best spring and brazing wire	1c.	" " " "

To customers who buy 5,000 lbs. or less per year.

	Net base per lb. High Brass.	Low Brass.	Bronze.
Sheet	$0.14	$0.15⅜	$0.16¼
Wire	.13⅜	.15⅜	.16¼
Rod	.13⅜	.16¼	.17¼
Brazed tubing	.18¼	——	.21
Open seam tubing	.18¼	——	.21
Angles and channels, plain	.18¼	——	.21

Net extra as shown in Brass Manufacturers' Price List.

NET EXTRAS FOR QUALITY.

Sheet—Extra spring, drawing and spinning brass	⅛c.	per lb. net advance
" —Best spring, drawing and spinning brass	1½c.	" " " "
Wire—Extra spring and brazing wire	⅛c.	" " " "
" —Best spring and brazing wire	1c.	" " " "

BARE COPPER WIRE—CARLOAD LOTS.

13c. per lb. base.

SOLDERING COPPERS.

300 lbs. and over in one order	18½c. per lb. base
100 lbs. to 300 lbs. in one order	19c. " " "
Less than 100 lbs. in one order	20½c. " " "

PRICES FOR SEAMLESS BRASS TUBING.

From 1¼ to 3½ O. D. Nos. 4 to 13 Stubs' Gauge, 16c. per lb.
Seamless Copper Tubing, 19½c. per lb.

For other sizes see Manufacturers' List.

PRICES FOR SEAMLESS BRASS TUBING Iron Pipe Sizes.

Iron pipe sizes with price per pound.

⅛	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	4½	5	6
24	23	18	17	16	16	16	16	16	16	16	17	18	20	22	23

PRICE LIST OF IRON LINED TUBING—NOT POLISHED.

	Per 100 feet Brass.	Bronze.
⅜ inch	$8	$9
½ inch	8	9
⅝ inch	10	11
¾ inch	12	13
⅞ inch	14	15
1 inch	18	20
1⅛ inch	22	24
1¼ inch	25	27
1½ inch	32	35
1¾ inch	45	48
2 inch	56	69

Discount 55-5%.

PRICE FOR TOBIN BRONZE AND MUNTZ METAL.

Tobin Bronze Rod	17c.	net base
Muntz or Yellow Metal Sheathing (14" x 48")	13½c.	" "
" " " " Rectangular sheets other than Sheathing	16c.	" "
" " " " Rod	13½c.	" "

Above are for 100 lbs. or more in one order.

PLATERS' METALS.

Platers' bar in the rough, 21½c. net.

German silver platers' bars dependent on the percentage of nickel, quantity and general character of the order.

Platers' metal, so called, is very thin metal not made by the larger mills and for which prices are quoted on application to the manufacturers.

PRICES FOR SHEET BLOCK TIN AND BRITANNIA METAL.

Sheet Block Tin—18" wide or less. No. 26 B. & S. Gauge or thicker. 100 lbs. or more 5c. over Pig Tin. 50 to 100 lbs. 6c. over, 25 to 50 lbs. 8c. over, less than 25 lbs. 10c. over.

No. 1 Britannia—18" wide or less. No. 26 B. & S. Gauge or thicker, 100 lbs. or more 4c. over Pig Tin. 50 to 100 lbs. 5c. over, 25 to 50 lbs. 7c. over, less 25 lbs. 9c. over.

Above prices f. o. b. mill.

Prices on wider or thinner metal on request.

PRICE SHEET FOR SHEET ALUMINUM—B. & S. Gauge.

Gauge.	Width. Inches.	1 ton.	500 lbs.	50 lbs.	Less than 50 lbs.
20 and heavier	3-30	30c.	34c.	36c.	38c.
	3-30	32c.	35c.	37c.	39c.
21 to 24 inclusive	30-48	33c.	37c.	39c.	41c.
	48-60	39c.	40c.	42c.	44c.
25 to 26	3-30	33c.	36c.	38c.	40c.
	30-48	35c.	38c.	40c.	42c.
27	3-30	36c.	37c.	39c.	41c.
	30-48	39c.	40c.	42c.	44c.
28	3-30	37c.	38c.	40c.	42c.
	30-48	40c.	41c.	43c.	45c.
29	3-30	38c.	39c.	41c.	43c.
	30-48	42c.	43c.	45c.	47c.
30	3-30	39c.	40c.	42c.	44c.

The above prices refer to lengths between 2 and 8 feet. Prices furnished by the manufacturers for wider and narrower sheet. No charge for boxing. F. O. B. Mill.

PRICE LIST SEAMLESS ALUMINUM TUBING.

STUBS' GAUGE THE STANDARD. SIZES CARRIED IN STOCK.
Outside Diameters. **BASE PRICE, 24 Cents per Pound.**

Stubs' Gauge.	Inches.	¼ in.	5-16 in.	⅜ in.	½ in.	⅝ in.	¾ in.	⅞ in.	1 in.	1¼ in.	1½ in.	1¾ in.	2 in.	2½ ins.	3 ins.	3½ ins.	4 ins.	4½ ins.
11.	.120.	..	..	..	..	..	..	..	26	23	..	..	13	10	9	8	15	22
12.	.109.	..	..	..	..	..	..	..	25	..	..	..	14	..	..	..	..	..
14.	.083.	..	..	..	..	..	..	..	..	..	..	..	16	..	..	..	..	..
16.	.065.	..	..	..	..	..	27	26	26	23	22	20	20	20	20	26	30	36
18.	.049.	..	..	..	..	32	29	28	27	24	25	25	25	..	..	..	..	..
20.	.035.	116	..	45	38	33	32	31	29	28	29	29	29	30	37	48	57	80
21.	.032.	..	..	..	39	..	..	..	..	..	..	..	..	..	..	..	..	..
22.	.028.	137	97	47	41	37	36	34	33	..	..	44	..	..	..	..	..	..
24.	.022.	187	132	107	87	78	72	61	59	65	..	..	..	..	..	..	..	..

Prices are for ten or more pounds at one time. For prices on sizes not carried in stock send for Manufacturers' List.

PRICE LIST FOR ALUMINUM ROD AND WIRE.

Diameter. B. & S. G'ge	000 to No. 10.	No. 11.	No. 12.	No. 13.	No. 14.	No. 15.	No. 16.	No. 17.	No. 18.	No. 19.	No. 20.	No. 21.	No. 22.
Price per lb.	33	33½	33½	34	34½	35	35½	36	37	38	39	44	47

BASE PRICE GRADE "B" GERMAN SILVER SHEET METAL.

Quality.	Net per lb.	Quality.	Net per lb.
5%	18¼c.	16%	22¾c.
8%	20c.	18%	23¼c.
10%	20½c.	20%	25½c.
12%	21½c.	25%	33⅜c.
15%	22½c.	30%	39¾c.

GERMAN SILVER WIRE.

Quality.	Net per lb.	Quality.	Net per lb.
5%	19¼c.	15%	26½c.
8%	21c.	16%	27½c.
10%	22½c.	18%	29¼c.
12%	24½c.	30%	45¼c.

The above Base Prices are subject to additions for extras as per lists printed in Brass Manufacturers' Price List and from such extras 50% discount will be allowed. The above base prices and discounts are named only to wholesale buyers who purchase in good quantities. Prices on small lots are considerably higher.

PRICES OF SHEET SILVER.

Rolled sterling silver .925 fine is sold according to gauge quantity and market conditions. No fixed quotations can be given, as prices range from 1c. below to 4c. above the price of bullion.

Rolled silver anodes .999 fine are quoted at 2½c. to 3½c. above the price of bullion.